

Hot Topic: Carotenoids In Food

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Carotenoids are the pigmented phytonutrients that give food that “healthy” appearance. The group includes beta-carotene (orange), lycopene (red) and xanthophylls lutein and its isomer zeaxanthin (yellow). Of the 600 naturally occurring carotenoids, 50 are found in food and 6 are found in human plasma. Only 2 are found in the human eye: lutein and zeaxanthin.

Lutein and zeaxanthin are found in the macula lutea of the eye and are known as the “yellow spot” in the retina. The highest concentration of zeaxanthin is at the fovea, the center of the macula. Lutein is found closer to the macula periphery. They function to absorb UV-blue wavelength light and act as antioxidants to protect cells from free radical damage.

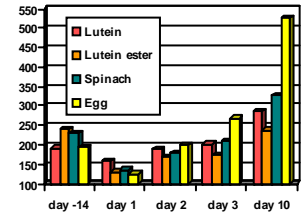
Besides being present in the eye, lutein and zeaxanthin are also found in varying concentrations in blood serum, adipose tissue, breast tissue and breast milk.



Humans are unable to synthesize lutein and zeaxanthin. USDA consumption surveys report a 5:1 dietary intake of lutein to zeaxanthin. The average adult intake has been reported to range between 950 mcg/d of lutein and 175 mcg/d of zeaxanthin or between 2-4mg/d of lutein and zeaxanthin together.

Within the American diet the most common sources of lutein are spinach, broccoli, squash, Brussels sprouts, peas, egg yolks and corn. The most common sources of zeaxanthin are sweet corn, persimmon, raw spinach collard greens, lettuce, cooked spinach and kale.

Most recently, lutein from eggs has been found to have a three fold higher bioavailability than from an equal quantity of cooked spinach or supplement intake.



Lutein Response in Serum
Chung et al. *J Nutr* 2004

Eye Health

Epidemiological research has shown an inverse relationship between lutein and zeaxanthin intake and diseases of the eye specifically those diseases most commonly associated with advanced age. Age related macular degeneration (AMD) is the leading cause of irreversible vision loss amongst the elderly. People are at a greater risk for developing

AMD if they are elderly, female, smokers, obese or have light eye color. Strong associations have been found between dietary intake of lutein and zeaxanthin, plasma lutein and zeaxanthin levels, macular pigment density and the risk of age related macular degeneration. In fact, macular pigment density has been found to increase with dietary intake while low levels of lutein and zeaxanthin

intake have been shown to increase the risk of AMD. (Richer et al. *Optometry* 2004) Another significant eye disease associated with both advanced age and xanthophyll intake is cataracts, the clouding of the cornea. Several studies have found a lower incidence of cataract extraction associated with the highest levels of lutein and zeaxanthin intake.

Where Carotenoids Are Found

600 in nature
50 in food supply
6 in human plasma
2 in the eye

Lutein and Zeaxanthin

Eye Health (continued)

Ongoing research is being conducted to learn more about the role of lutein and zeaxanthin in eye health. Lutein and zeaxanthin are considered important factors in improving vision and reducing the cumulative effects of retinal damage due to light and oxygen exposure.

Hammond et al. (*Arch Biochem Biophys*, 2001) reported that intake of these carotenoids improves visual acuity by absorbing short wave light which is easily scattered and poorly focused. Most recently, The Lutein Antioxidant Supplementation Trial (Richer et al. *Optometry*, April 2004) concluded that adequate lutein and zeaxanthin intake can slow and even reverse the progression of AMD.

The lipid matrix of the egg yolk provides a vehicle for the efficient absorption of dietary lutein and zeaxanthin. Such a lipid matrix may be optimal for carotenoid absorption from the diet.

Am J Clin Nutr
1999;70:247-51.

Aside from the eyes, skin is another bodily organ that experiences frequent damage from free radicals due to exposure to sunlight and pollution. (skin graphic) Blue light, the UV rays that penetrate the skin's deepest layers, are considered the most damaging. Because of lutein's ability to absorb blue light and inhibit lipid peroxidation, lutein and zeaxanthin are considered

Several studies have looked at the association between lutein and zeaxanthin intake and the incidence of colon cancer. In a large case controlled study, Slattery et al. found an inverse association between dietary lutein intake during the two years prior to diagnosis and colon cancer detection. Similarly, Levi et al. reported the observance of an inverse association between lutein plus zeaxanthin intake during the two years prior to diagnosis and the risk of colon cancer in the 714 subjects participating in a case controlled study. McMillian et al. identified an inflammatory response in cancer patients as reflected by an elevated C-reactive protein in which treatment with an anti-inflammatory agent resulted in small but significantly

increased plasma carotenoid concentrations. This observation indicates a potential role of inflammation in the regulation of plasma lutein and other carotenoids which has been demonstrated in gastrointestinal and lung cancer as well.



Skin Health

important antioxidants in the protection of human skin from the harmful effects of environmental exposure. Since topical application of carotenoids is unable to reach the lower layer (dermis) of the skin, oral carotenoid intake appears to be the most reliable route of prevention. Mice fed dietary lutein exhibited less skin inflammation and skin tissue oxidation when exposed to ultraviolet light radiation. (Lee et al. *J Invest Dermatol*

2004) Interestingly, new research with subjects having past histories of basal cell carcinoma indicates that oral ingestion of lutein and zeaxanthin may have the potential to act as a chemopreventative factor against certain types of melanoma (skin cancer). (Dorgan, *Can Epid Bio Prev*, 2004)

Conclusions

As more research documents the importance of carotenoids in the food supply the message becomes clear: foods should not be eliminated from our diet but eaten with variety and moderation in mind. Eggs have been shown to supply many nutrients that promote health and the xanthophylls in eggs, help slow cellular damage due to the effects of aging and environmental exposure.

Women's Health

Lutein distribution within the body differs between men and women. Men appear to have their highest lutein concentration in the eye whereas women have higher serum and adipose tissue levels. Lutein has been found in the umbilical cord plasma as well as in breast milk, leading to speculation that lutein is needed

by the developing fetus and newborn infant. In addition, two studies (Yeum et al. *J Nutr* 1998 and Tonoiolo et al., *Am J Epidemiol* 2001) have found lutein concentrations in breast tissue to be inversely associated with breast cancer risk, indicating an association between carotenoids and female metabolism.



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