

## ROLE OF NUTRITION IN MAINTAINING NORMAL EYESIGHT-A REVIEW

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### Abstract

The eye is particularly susceptible to oxidative stress as a result of its high oxygen consumption, high concentration of polyunsaturated fatty acids and cumulative exposure to high-energy visible light. This combination of factors leads to the generation of reactive oxygen species that can trigger oxidative damage to ocular tissues. There is evidence that the human consumer should avoid excessive supplementation with carotenoids. Poly-unsaturated fatty acids are linked to eye disease (as well as multiple other chronic diseases) in both positive and negative ways. Dietary poly-unsaturated fatty acids fall into two major groups, *i.e.*, omega-6 (mainly linoleic acid and arachidonic acid) and omega-3 fatty acids, mainly alpha-linolenic acid, *eicosapentaenoic acid* (EPA) and *docosahexaenoic acid* (DHA). Vitamin A deficiency is rare in the United States, but it is common among the poor in developing countries. It's estimated that approximately 250,000 to 500,000 malnourished children worldwide become blind each year due to vitamin A deficiency that could have been prevented with a proper diet. A lack of vitamin A causes the cornea to become very dry, leading to clouding of the front of the eye, corneal ulcers and vision loss. Vitamin A deficiency also causes damage to the retina, which also contributes to blindness.

**Keywords:** Vitamin A, DHA, Glaucoma, retinopathy

### Introduction

Vitamin A helps protect of the eye (cornea), it is essential for good vision Studies show vitamin A eye drops are effective for the treatment of dry eyes. In fact, one study found that over-the-counter lubricating eye drops containing vitamin A were as effective for the treatment of dry eye syndrome as more expensive prescription eye relief.

Your risk of developing an eye disease increases as you get older. The most common eye diseases include:

- **Cataracts.** A condition in which lens become clouded. Age-related cataracts are a leading cause of vision impairment and blindness around the world.
- **Diabetic retinopathy.** Associated with diabetes and a major cause of visual impairment and blindness, retinopathy develops when high blood sugar levels damage the blood vessels in your retina.
- **Dry eye disease.** A condition marked by insufficient production of tear, which causes your eyes to dry up and leads to discomfort and potential visual problems.
- **Glaucoma.** A group of diseases characterized by progressive degeneration of optic nerve. Glaucoma may cause poor eyesight or blindness.
- **Macular degeneration.** The macula is the central part of your retina. Age-related macular degeneration (AMD) is

one of the main causes of blindness in developed countries.[1]

Globally, approximately 250 million people suffer from varying degrees of vision loss [2]. Leading causes include several eye conditions considered in this Special Issue, such as cataract, AMD, glaucoma, and diabetic retinopathy. These conditions disproportionately affect older adults, and with an ageing population the number of affected individuals is predicted to increase exponentially [2]. Whilst the etiology of age-related eye disease is complex and multifactorial, oxidative stress has been implicated as a common causative mechanism. The eye is particularly susceptible to oxidative stress as a result of its high oxygen consumption, high concentration of polyunsaturated fatty acids and cumulative exposure to high-energy visible light. This combination of factors leads to the generation of reactive oxygen species that can trigger oxidative damage to ocular tissues. Consequently, there has been significant research interest in the role of dietary antioxidants and the potential therapeutic benefits of antioxidant vitamin and mineral supplements as a simple and cost-effective strategy for disease prevention and control[3–5].

The present overview places carotenoids into the context of [6] familiar organisms and objects colored by carotenoids, [7] their roles in human vision, with an emphasis on protection by zeaxanthin and lutein against

vision loss, [8] synergistic interactions of zeaxanthin and lutein with other dietary factors affect human vision, and [9] a comparison of the photo-physics of light collection and photoprotection in photosynthesis and vision and their common principles that might be rewarding targets of future research.[10]

There is evidence that the human consumer should avoid excessive supplementation with carotenoids [11,12]. For example, daily supplementation with excessive amounts of  $\beta$ -carotene for several years actually increased the risk of lung cancer of male. In addition, blue- green algal (cyanobacterial) supplements (with high levels of a class of highly oxygenated xanthophylls called ketocarotenoids) caused crystalline ketocarotenoid deposits in the human eye [13]. Currently available blue- green algal supplements thus need to be viewed with caution, due to potential adverse effects of ketocarotenoid accumulation.

#### Yellow food:

Eggs, yellow corn, and yellow peppers are probably the richest dietary sources of zeaxanthin and lutein in the United States. These food sources receive all of their yellow-to-orange color from their zeaxanthin and lutein content. In contrast, green leafy plant foods typically contain high levels of lutein, but very.[14]

Just as is the case for animals, plants and algae also use carotenoids for *both light collection AND photoprotection* against the destructive effects of intense light. The xanthophylls zeaxanthin and lutein stand out as primary agents of photoprotection in plants. Zeaxanthin facilitates the safe removal of potentially damaging excessive excitation energy [15,16]; zeaxanthin's close isomer lutein plays a minor role in the same process of the dissipation of excessive excitation [17]. In addition, zeaxanthin also provides plant photoprotection by direct inhibition of the oxidation of lipids of the photosynthetic membrane (lipid peroxidation);[18,19]

Exposure to reactive oxygen (readily formed in highly oxygenated tissues, such as the human eye) leads to preferential peroxidation of poly-unsaturated fatty acids. Poly-unsaturated fatty acids are linked to eye disease (as well as multiple other chronic diseases) in both positive and negative ways. Dietary poly-unsaturated fatty acids fall into two major groups, *i.e.*, omega-6 (mainly linoleic acid and arachidonic acid) and omega-3 fatty acids, mainly alpha-linolenic acid, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). A balanced ratio of dietary omega-6 to omega-3 fats (below 10:1 and perhaps as low as 2:1) is needed to support human health (including the health of the human eye), while the modern western diet provides a highly unbalanced ratio of about 10–20:1 [20].

#### Sweet potatoes and carrots:

- Sweet potatoes and carrots are excellent sources of provitamin A carotenoids that are good for your eyes:
- Vitamin A from animal-derived foods is called retinol. This "pre-formed" vitamin A can be used directly by the body. Good food sources of retinol vitamin A include beef and chicken liver, whole milk and cheese.
- Vitamin A obtained from colorful fruits and vegetables is in the form of "provitamin A" carotenoids, which are converted to retinol by the body after the food is ingested. Good food sources of provitamin A carotenoids include carrots, sweet potatoes, spinach, kale and cantaloupes.

#### Eye Benefits of Vitamin A and Beta-Carotene

Vitamin A eye drops also have been shown effective for the treatment of a specific type of eye inflammation called Vitamin A, at least when in combination with other antioxidant vitamins, also appears to play a role in decreasing the risk of vision loss from macular degeneration (AMD). In the landmark Age-Related Eye Disease Study (AREDS) sponsored by the National Eye Institute, people with mild or moderate AMD who took a daily multivitamin that included vitamin A (as beta-carotene), vitamin C, vitamin E, zinc and copper had a 25 percent reduced risk of advanced AMD during a six-year period.[21]

It also appears that a combination of vitamin A and lutein may prolong vision in people suffering from retinitis pigmentosa (RP). A four-year study conducted by researchers from Harvard Medical School and other prominent universities found that individuals with retinitis pigmentosa who took daily supplements of vitamin A (15,000 IU) and lutein (12 mg) had a slower loss of peripheral vision than those who did not take the combined supplements. Because beta-carotene is converted into vitamin A in the body, it's likely this provitamin A offers similar eye benefits as the pre-formed retinol type of vitamin A, though more research is needed to confirm this. Researchers at Columbia University Medical Center found that a synthetic, altered form of vitamin A might be able to slow the progression of Stargardt's disease, an inherited eye disease that causes severe vision loss in young people.

When given to mice with the same genetic defect as humans with Stargardt's disease (also called juvenile macular degeneration), the modified vitamin A inhibited the growth of clump-like deposits in the retina called "vitamin A dimers" that are associated with degenerative changes and vision loss. The National Eye Institute has awarded the researchers a \$1.25 million grant to further investigate the link between vitamin A dimers and various retinal degenerations, which could lead to new approaches to treat these diseases.

### Vitamin A Deficiency

Vitamin A deficiency is rare in the United States, but it is common among the poor in developing countries. It's estimated that approximately 250,000 to 500,000 malnourished children worldwide become blind each year due to vitamin A deficiency that could have been prevented with a proper diet. One of the first signs of vitamin A deficiency is night blindness. In ancient Egypt, it was discovered that night blindness could be cured by eating liver, which later was found to be a rich source of vitamin A. A lack of vitamin A causes the cornea to become very dry, leading to clouding of the front of the eye, corneal ulcers and vision loss. Vitamin A deficiency also causes damage to the retina, which also contributes to blindness. Because vitamin A also is important for resistance to infection and a healthy immune system, vitamin A deficiency can lead to death from respiratory and other infections.[22]

#### Vitamin A - Daily Value:

In most cases, it's best to obtain vitamins and minerals from a healthy, balanced diet. The concept of the Daily Value (DV) was developed to help consumers determine if a food contains a lot or a little of a nutrient, based on its Recommended Dietary Allowance. The DV for vitamin A is 5,000 IU.

#### A healthy diet for your eyes should include plenty of colorful fruits and vegetables:

Incorporating the following foods in your diet will help you get the Recommended Dietary Allowance (RDA) of these important eye nutrients. Established by the Institute of Medicine (National Academy of Sciences),[23] the RDA is the average daily dietary intake level of a nutrient sufficient to meet the requirements of nearly all healthy individuals in a specific life stage and gender group.

While the RDA is a useful reference, some care practitioners recommend higher daily intakes of certain nutrients for people at risk for eye problems. (In the following list, mg = milligram; mcg = microgram (1/1000 of a mg) and IU = International Unit.)

#### Beta-carotene

- Eye benefits of beta-carotene: When taken in combination with zinc and vitamins C and E, beta-carotene may reduce the progression of macular degeneration.
- Food sources: Carrots, sweet potatoes, spinach, kale, butternut squash
- RDA: None (most supplements contain 5,000 to 25,000IU).

### Bioflavonoids (Flavonoids)

- Eye benefits of bioflavonoids: May protect against cataracts and maculardegeneration.
- Food sources: Tea, red wine, citrus fruits, bilberries, blueberries, cherries, legumes, soyproducts
- RDA: None

#### Lutein and Zeaxanthin

- Eye benefits of lutein and zeaxanthin: May prevent cataracts and maculardegeneration
- Food sources: Spinach, kale, turnip greens, collard greens,squash
- RDA:None

#### Omega-3 Fatty Acids

- Eye benefits of omega-3 fatty acids: May help prevent macular degeneration (AMD) and dryeyes
- Food sources: Cold-water fish such as salmon, mackerel and herring; fish oil supplements, freshly ground flaxseeds,walnuts
- RDA: None; but for cardiovascular benefits, the American Heart Association recommends approximately 1,000 mgdaily.

#### Selenium

- Eye benefits of selenium: When combined with carotenoids and vitamins C and E, may reduce risk of advanced AMD
- Food sources: Seafood (shrimp, crab, salmon, halibut), Brazil nuts, enriched noodles, brownrice
- RDA: 55 mcg for teens and adults (60 mcg for women during pregnancy and 70 mcg whenbreast-feeding).

#### Vitamin A

1. Eye benefits of vitamin A: May protect against night blindness and dryeyes
2. Food sources: Beef or chicken liver; eggs, butter, milk.
3. RDA: 3,000 IU for men; 2,333 IU for women (2,567 IU during pregnancy and 4,333 IU whenbreast-feeding).

#### Vitamin C

- Eye benefits of vitamin C: May reduce the risk of Food sources: Sweet peppers (red or green), kale, strawberries, broccoli, oranges,cantaloupe
- RDA: 90 mg for men; 70 mg for women (85 mg during pregnancy and 120 mg whenbreast-feeding).

#### Vitamin D

- Eye benefits of vitamin D: May reduce the risk of maculardegeneration

- Food sources: Salmon, sardines, mackerel, milk; orange juice fortified with vitamin D
- RDA: None, but the American Academy of Pediatrics recommends 400 IU per day for infants, children and adolescents, and many experts recommend higher daily intakes for adults.
- The best source of vitamin D is exposure to sunlight. Ultraviolet radiation from the sun stimulates production of vitamin D in human skin, and just a few minutes of exposure to sunlight each day (without sunscreen) will insure your body is producing adequate amounts of vitamin D.

### Vitamin E

- Eye benefits of vitamin E: When combined with carotenoids and vitamin C, may reduce the risk of advanced AMD
- Food sources: Almonds, sunflower seeds, hazelnuts.
- RDA: 15 mg for teens and adults (15 mg for women during pregnancy and 19 mg when breast-feeding).

### Zinc

- Eye benefits of zinc: Helps vitamin A reduce the risk of night blindness; may play a role in reducing risk of advanced AMD
- Food sources: Oysters, beef, Dungeness crab, turkey (dark meat).
- RDA: 11 mg for men; 8 mg for women (11 mg during pregnancy and 12 mg when breast-feeding).

### Conclusion:

In general, it's best to obtain most nutrients through a healthy diet, including at least two servings of fish per week and plenty of colorful fruits and vegetables. If you plan to begin a regimen of eye vitamins, be sure to discuss this with your optometrist or ophthalmologist. Taking too much of certain vision supplements can cause problems, especially if you are taking prescription medications for health problems. It also appears that a combination of vitamin A and lutein may prolong vision in people suffering from retinitis pigmentosa (RP). A four-year study conducted by researchers from Harvard Medical School and other prominent universities found that individuals with retinitis pigmentosa who took daily supplements of vitamin A (15,000 IU) and lutein (12 mg) had a slower loss of peripheral vision than those who did not take the combined supplements. Because beta-carotene is converted into vitamin A in the body, it's likely this provitamin A offers similar eye benefits as the pre-formed retinol type of vitamin A, though more research is needed to confirm this.

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