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REPORT

Protecting Our Eyes Against Time-Induced Damage

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By the age of 65 years, nearly one-third of adults will experience age-related damage to their eyesight.¹ The leading cause of age-related central blindness is macular degeneration, which can rob us of the ability to read and see fine details. Cataracts are a frequent cause of damage to the crystalline lens of the eye, and can result in blindness.

Age-associated vision loss is not inevitable. In fact, nutrients like lutein, zeaxanthin, and meso-zeaxanthin provide critical antioxidant and light-filtering properties to the eye lens and macula—structures essential for clear vision.^{2,3} Not only do these nutrients guard against vision loss⁴—growing evidence suggests they also protect against other ailments such as cancer and cognitive decline.⁵⁻⁷

Although deteriorating vision is often accepted as an inevitable part of aging, we're learning today that this does not have to happen. A remarkable number of clinical studies are teaching us how the most common causes of age-related vision loss can be prevented—if we take prompt action.

Scientists are finding that deficiencies in certain plant-derived compounds can cause vision to degrade over time.⁴ To understand just how these nutrients produce their benefits, let's take a look at how humans usually lose their vision with age. Two major culprits are age-related macular degeneration and cataracts. Both are potentially preventable if early action is taken.⁸ Nutrients like meso-zeaxanthin may even help reverse the most common form of blindness afflicting aging eyes.⁴

AGE-RELATED MACULAR DEGENERATION

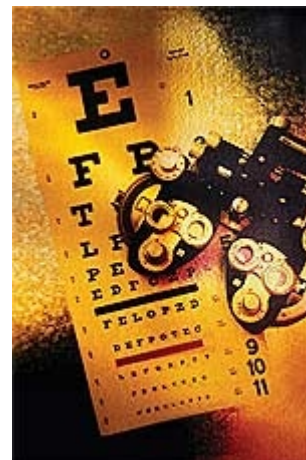
Macular degeneration is a leading cause of blindness in adults.^{9,10} It results from progressive loss of light-sensing nerve cells in the macula, or central part of the retina, where these cells are most densely packed. The macula therefore provides us with the greatest amount of visual acuity—the ability to see fine details.¹¹ As macular degeneration progresses, people lose central vision, gradually diminishing their ability to distinguish facial features, to read, and to engage in the many daily activities that require sharp vision. These effects are tragic, heartbreaking, and also extremely costly to our society in terms of health care.¹²

CATARACTS

Another chief cause of blindness in adults is cataracts,^{1,13} in which lens disruptions cause light to bend and scatter in ways that prevent the formation of a sharp image on the retina.¹⁴ From the outside, fully developed cataracts give the lens an appearance of being dull or even opaque. On the inside, the result is a loss of visual acuity and light that reaches the retina. Like macular degeneration, the incidence of cataracts increases progressively with advancing age; unlike macular degeneration, however, surgical treatment is available and effective, though expensive and not without risk.¹⁵

ZEAXANTHIN AND LUTEIN—PROTECTION FROM THE DARK SIDE OF LIGHT

There is now considerable evidence that dietary zeaxanthin and lutein play an important role in protecting against the ravages of both macular degeneration and cataracts.⁴ Concentrated in the lens and the retina, these carotenoids are, in fact, responsible for the golden-yellow color of the healthy retinal macula,^{21,22} which fulfills two essential functions—filtering ultraviolet (UV) light and fighting oxidative damage.



By filtering UV and blue light, which is destructive to retinal cells,^{11,23} zeaxanthin and lutein act as a sort of built-in sunscreen.^{22,23} The nutrients are also potent antioxidants, “quenching” the destructive free radicals produced when light energy interacts with delicate tissues within the eye.²³⁻²⁷ Oxidant stress is a contributor to (and a result of) the inflammatory changes that accompany age-related macular degeneration,⁹ lending even more importance to the antioxidant function of these nutrients.



The dual actions of zeaxanthin and lutein as free radical-quenching light-absorbers, strategically distributed in both the lens and retina, makes them ideal natural protectors of vision.^{21,23}

EVIDENCE FOR ZEAXANTHIN AND LUTEIN IN EYE DISEASES

Higher oral ingestion of zeaxanthin and lutein results in greater stores of these nutrients in the lens and retina, preventing common eye disorders. Dr. Eamonn O’Connell of the Department of Ophthalmology at Waterford Regional Hospital in Ireland notes, “Evidence continues to accumulate that oxidative stress is important in age-related maculopathy [equivalent to age-related macular degeneration] and that appropriate antioxidants of dietary origin may protect against this condition.”²⁸ In a study published just this year, Dr. O’Connell and colleagues recorded dietary information from 828 Irish subjects aged 20-60 years old, and looked for associations with age-related maculopathy. Disturbingly, they found that increasing age was directly associated with a relative lack of zeaxanthin in the diet. That is particularly unfortunate, because other studies have shown that increased zeaxanthin and lutein intake, along with higher blood levels of the nutrients, are associated with lower rates of age-related macular degeneration and cataracts.^{21,29}

In fact, epidemiologists at the Massachusetts Eye and Ear Infirmary in Boston studied 356 people aged 55-80 years with advanced macular degeneration, and compared them with 520 control subjects who had other eye diseases.¹⁰ These scientists found a 43% decrease in macular degeneration rates among people with the highest dietary carotenoid intakes (particularly zeaxanthin and lutein), compared with those who had the lowest intakes.

Another group of Irish scientists studied the density of macular pigments, which are primarily composed of zeaxanthin, lutein, and meso-zeaxanthin, in 828 healthy subjects.² They found a significant age-related decline in the density of these vital protective macular pigments, which was worse in smokers and those with a family history of age-related macular degeneration.

A compelling study that helped to relate zeaxanthin and lutein intake to macular health was the large “Age-Related Eye Disease Study” (AREDS). One group of AREDS scientists studied 4,519 participants aged 60-80 years, estimating their nutritional intake and conducting periodic eye exams for evidence of macular degeneration.³⁰ They found that people with the highest intake of zeaxanthin and lutein in their diets had a decrease in signs of age-related macular degeneration on eye examination, ranging from 27% to 55%, depending on the specific measurement used. The authors’ conclusion was that higher intake of zeaxanthin and lutein was independently associated with a decreased likelihood of age-related macular degeneration.



Similar effects have been reported with regard to cataracts, another leading cause of age-related visual problems. For example, researchers in Spain studied 177 adults 65 years and older, monitoring their dietary intake for a week and comparing it with the occurrence of cataracts and lifetime history of sun exposure.³¹ As expected, the cataract rate was highest among those with greater lifetime sun exposure—but high lutein intake protected both men and women against cataracts, and high zeaxanthin intake protected against cataracts in men.

Lutein and zeaxanthin are known as carotenoids because they were indeed first discovered in carrots.¹⁶⁻¹⁸ Zeaxanthin and lutein can be found in dietary sources such as egg yolks and vibrantly colored fruits and vegetables such as dark leafy greens, corn, and tangerines.³

Australian researchers extended those findings in a study of 2,322 people 40 years and older, whom they followed for five years.³² Astonishingly, the scientists found a 40% lower rate of cataracts occurring at the center of the lens for every 1 mg increase in their daily intake of lutein and zeaxanthin! Like the other researchers, these authors concluded that high dietary intake of these nutrients was associated with significantly lower rates of cataracts. Other large-scale epidemiological studies continue to reinforce these observations, with reports of reductions in cataract rates of 18%³³ to 32%²⁹ in groups of people with high dietary intakes of lutein and zeaxanthin.

WHAT YOU NEED TO KNOW: PREVENTING AGE-RELATED BLINDNESS

- Severe loss of vision and even blindness may affect millions of aging Americans each year.
- Age-related macular degeneration and cataracts together cause most of the vision loss experienced by adults.

- Both age-related macular degeneration and cataracts are the direct results of the punishing effects of light exposure on delicate structures in the eye.
- Natural golden-yellow pigments called zeaxanthin and lutein filter out the most damaging forms of light to protect the eye, while their natural antioxidant powers augment that protection by “quenching” free radicals produced by light.
- Daily supplementation with zeaxanthin and lutein has been shown to provide dramatic improvements in eye structure and function, especially in patients with age-related macular degeneration. A related supplement called meso-zeaxanthin also shows promise in promoting macular health.
- Doses of zeaxanthin used in eye studies have ranged from as little as 1 mg/day to as high as 30 mg/day, and of lutein from 2.4 mg/day to 30 mg/day with no adverse effects.^{25,36} A recent very large trial showed that a supplement containing 10-20 mg/day of lutein and zeaxanthin together produced the best concentrations of these pigments throughout the retina.⁴¹
- Like other carotenoid nutrients, lutein and zeaxanthin may be best absorbed when consumed with a source of dietary fat. Certain medications, foods, and nutritional substances may decrease the absorption of lutein and zeaxanthin. These include the cholesterol-lowering medications cholestyramine and cholestipol, corn oil, and pectin.³
- Zeaxanthin and lutein are now showing great promise in skin protection as well as prevention of oxidant-related diseases associated with advancing age, such as cancer, cardiovascular disease, and cognitive decline.

LIGHT-PROTECTIVE SUPPLEMENTATION THAT WORKS

Aging people who do not get enough zeaxanthin and lutein are at substantially increased risk for eye diseases. The past few years have seen an abundance of scientific studies showing that these nutrients can make a difference, especially if started early when chronic light-related damage is minimal.

Encouraged by prior studies in other eye diseases,³⁴ Dr. Richard Bone of Florida International University and colleagues were among the first scientists to show that lutein supplements in doses ranging from 2.4 to 30 mg/day, along with a single dose of zeaxanthin increased optical density of the protective pigments in the macula,²⁵ where the greatest protection is needed. Similar results have been found in other studies,³⁵⁻³⁷ some of which combined zeaxanthin and lutein with other antioxidant vitamins and minerals.³⁶

A group of Italian ophthalmologists also confirmed the power of nutritional supplementation to improve retinal function.³⁸ The scientists measured changes in retinal function over a 180-day period in patients with early age-related macular degeneration, of whom 17 received a daily antioxidant supplement (15 mg lutein, 20 mg vitamin E, and 18 mg nicotinamide [a B vitamin]) and 13 received no dietary supplementation. The study also included eight people with healthy eyes, four of whom took the same supplement and four who did not. The results were compelling—retinal activity was substantially higher for all supplemented patients, while no beneficial change was seen in any of the unsupplemented group. In addition, the ability to detect light at lower levels was increased in the supplemented group. In the authors’ own words, “the results suggest that increasing the level of retinal antioxidants [notably including lutein] might influence macular function early in the disease process, as well as in normal aging.”

In 2004, a research group led by Dr. Stuart Richer of the Veteran’s Affairs Medical Eye Clinic in Chicago published a rigorous trial of lutein, with or without additional antioxidants, in patients with age-related macular degeneration.³⁹ This carefully designed study included 90 patients over a 12-month period, divided into three treatment groups. One group received daily 10 mg lutein supplements alone, a second group received lutein 10 mg along with an antioxidant

vitamin/mineral mix, and a third group received a placebo. The eye experts studied both retinal pigment levels as well as actual changes in vision at baseline and after 12 months of treatment. Supplementation produced clear benefits—density of protective retinal pigment increased significantly in both lutein-supplemented groups, while visual acuity increased for both the lutein-only and the lutein plus antioxidant groups. Lutein-only treated patients also reported a subjective improvement in their vision on a standard scale, while placebo recipients had no significant change in any of the measured outcomes. A subsequent study by Dr. Richer led him to conclude that “effective interventions [supplements] should be able to re-establish this protective barrier [macular pigments].”⁴⁰

A nutritional cousin of lutein and zeaxanthin called meso-zeaxanthin is attracting attention for its application in eye health.^{3,19,20} Though not present in the typical diet, meso-zeaxanthin is produced from lutein in the retina.^{3,20} Together with lutein and zeaxanthin, meso-zeaxanthin helps comprise the macular pigment, the region of the eye's retina that is crucial to detailed vision.³ Like many other biochemical processes, however, the conversion of lutein to meso-zeaxanthin is reduced by aging. A deficiency in meso-zeaxanthin can therefore result in a reduction in macular pigment density. Furthermore, a lack of ingested lutein or difficulty in synthesizing meso-zeaxanthin from lutein can further reduce levels.



Fortunately, meso-zeaxanthin can be obtained as a nutritional supplement to overcome these deficiencies and bolster declining levels with aging. An intriguing study showed that when individuals supplemented with meso-zeaxanthin, their macular pigment density increased.¹⁹ Since optimal macular pigment density is crucial to visual health, this suggests that supplementing with meso-zeaxanthin—in addition to consuming abundant lutein and zeaxanthin—may help keep macular degeneration at bay.³

More details about how these benefits arise became evident just last year, when Swiss scientists found that lutein, zeaxanthin, or the combination at doses of 10 or 20 mg/day could increase the density of macular pigments.⁴¹ In their patients, the average plasma concentration of these pigments was increased by up to 27-fold. The researchers found that lutein wound up primarily in the most central region of the retina, while zeaxanthin was deposited over a wider area, suggesting again that both nutrients are needed for maximum retinal health.

Still more compelling information on how both supplements promote improved vision was published this year.⁴² Italian ophthalmologists randomized 27 patients with early age-related macular degeneration to receive either an oral daily supplement containing 10 mg lutein, 1 mg zeaxanthin, and other anti-oxidants or no supplementation. After 6 and 12 months, the supplemented patients showed highly significant increases in electrical activity in the central areas of their retinas (where maximum visual acuity is generated), while unsupplemented patients showed no changes at all. The researchers concluded that “in non-advanced AMD eyes, a selective dysfunction in the central retina can be improved by supplementation with carotenoids [lutein and zeaxanthin] and antioxidants.”⁴²

It is now clear that, in the words of Francis E. Cangemi, one of the nation's leading experts on age-related macular degeneration, “Nutritional supplements have become the first line of defense for clinicians in battling dry AMD.”⁴³ This statement was made in the context of a 2007 report on the “TOZAL” study, evaluating the impact of a supplement containing lutein 8 mg and zeaxanthin 0.4 mg along with taurine, omega-3 fatty acids, and antioxidant vitamins and minerals for “dry” age-related macular degeneration. This is the form of the disease in which there is no “leakage” of material from retinal blood vessels.

The supplement was provided to 37 older adults (average age of 76 years). Of the supplemented patients, 77% experienced stabilization or improvement in visual acuity. Remember, these are patients whose visual acuity would otherwise steadily decline over time.

OTHER EFFECTS OF ZEAXANTHIN AND LUTEIN

New benefits of zeaxanthin and lutein on other age-related diseases are emerging daily.⁴⁴ A brief summary of other health benefits with these powerful pigments is provided below.

INTERNAL SUNGLASSES

Since zeaxanthin and lutein act like a form of “sunscreen” for the eyes, vision scientists studied the effects of these light-absorbing nutrients on light glare, a common problem for drivers, pilots, and anyone who needs to maintain good vision under brightly lit conditions.³⁷ The scientists found that in 40 healthy young subjects, those with higher pigment levels did better on visual tasks done under conditions of bright glare. After 6 months of lutein/zeaxanthin supplementation (12 mg/day), pigment density was significantly increased, and subjects performed dramatically better on all of the glare tasks. In essence, this study provided the subjects with “internal sunglasses” that helped them cope with glaring light!

EXTERNAL SUN PROTECTION

In a similar fashion, these carotenoids might help work like a natural sun protector for the skin. Harvard scientists have now demonstrated that supplementation with zeaxanthin and lutein can protect skin cancer-prone mice from damaging UV radiation.⁴⁵ Animals fed the supplement showed increased tumor-free survival time and reduced incidence of tumors. Importantly, the scientists also studied the “photo-aging” effects of light, demonstrating that the skin of the supplemented animals showed fewer age-related changes, compared with the control subjects.

Plastic surgeons in Italy took the next logical step of studying the effects of supplementation on human skin.⁴⁶ Using human volunteers, the researchers studied five skin physiology factors related to aging and cancer susceptibility, providing zeaxanthin and lutein supplements orally, topically, or in combination. The combined oral and topical supplementation provided the highest degree of antioxidant protection. The separate treatments did provide some protection, with the oral route clearly superior in terms of changes induced by UV light. It seems likely that further studies will even more strongly validate the many ways in which these nutrients can protect our bodies from the damaging effects of sunlight.

CANCER PREVENTION

Antioxidant nutrients are thought to decrease the risk of certain cancers by limiting oxidative damage to DNA. The strong association between inflammation and cancer,⁴⁷ coupled with the known effects of oxidation on inflammation,⁴⁸ adds to the anticancer potential of antioxidant nutrients as well. The anti-oxidant powers of lutein and zeaxanthin are now being actively explored for their potential as cancer-preventing agents.

For example, epidemiologist Jianjun Zhang, of the University of Arkansas for Medical Sciences and colleagues studied 193 men with prostate cancer, comparing their blood levels of carotenoids (including zeaxanthin and lutein) with those of 197 cancer-free control patients. Subjects with the highest plasma levels of these essential nutrients had a 55% lower risk of prostate cancer than those with the lowest levels.⁵

Another carefully designed study of carotenoid intake among Chinese women with ovarian cancer found similarly intriguing results.⁴⁹ Researchers compared 254 women with confirmed cancers with 652 healthy control patients, rigorously noting their dietary intake according to a USDA standard database. A remarkable 55% lower risk of ovarian cancer was seen in women with the highest levels of lutein and zeaxanthin intake. These two rigorously designed studies go a long way to establishing the anticancer properties of lutein and zeaxanthin.

LUTEIN AND ZEAXANTHIN BASICS

Lutein and zeaxanthin are known as carotenoids because they were indeed first discovered in carrots.¹⁶⁻¹⁸ Zeaxanthin and lutein can be found in dietary sources such as egg yolks and vibrantly colored fruits and vegetables such as dark leafy greens, corn, and tangerines.³

COGNITIVE DECLINE

There is a wealth of evidence that age-related cognitive decline is partly the result of cumulative oxidant injury to brain cells. Some of the most recent and compelling data have come from a large French research program called the “EVA” study.^{50,51} EVA scientists tracked several thousand high-functioning older adults and found that those with low values of antioxidants (especially carotenoids) in their blood had consistently lower scores on tests of cognition.

A follow-up study of EVA participants was published in 2007, specifically evaluating the relationship between plasma carotenoids and cognitive performance in 589 adults with an average age of 74 years.⁷ Participants with the lowest level of cognitive function were nearly twice as likely to have low zeaxanthin levels as were people at the top of their game cognitively. As the authors concluded, “Our results suggest that low carotenoid levels could play a role in cognitive impairment.”

CARDIOVASCULAR BENEFITS

Any nutrient with powerful antioxidant effects is likely to provide significant cardiovascular benefits, given what we now know about oxidation, inflammation, and atherosclerosis. Scientists are finding this to be true of the carotenoids including lutein and zeaxanthin. Swedish researchers studied 89 patients with coronary artery disease and 50 healthy controls.⁶ Subjects with heart disease had lower carotenoid

levels, especially total lutein plus zeaxanthin, than control patients. Those low levels were also correlated with smoking, obesity, low high-density lipoprotein (HDL), and inflammatory activity, all of which are well-established cardiovascular risk factors. Whether these low levels are a cause or an effect of the oxidative stress seen in cardiovascular disease remains to be seen—but these results strongly suggest that boosting combined lutein and zeaxanthin levels could be protective. That idea is supported by a University of Minnesota study in 2007 showing that patients with the highest blood levels of carotenoids, including zeaxanthin and lutein, had the lowest levels of molecules associated with inflammation, oxidative stress, and endothelial dysfunction, all of which are known risk factors for cardiovascular disease.⁵²

SUMMARY

Modern scientific studies have shown impressive benefits for our eyes with meso-zeaxanthin, zeaxanthin, and lutein. These

specialized carotenoid nutrients help prevent the damage we experience that results in macular degeneration and cataracts. Strong evidence suggests that most aging people do not get adequate amounts of zeaxanthin and lutein in their diets. Furthermore, the process of aging decreases our body's ability to generate meso-zeaxanthin from lutein, and therefore supplementation provides powerful benefits in the context of aging. Furthermore, the benefits of these specialized carotenoids apply in other parts of the body as well—not only in light-sensitive organs like the skin, but also in other tissues like the cardiovascular system and the brain where the ravages of age rob us of our health and vitality.

If you have any questions on the scientific content of this article, please call a Life Extension Health Advisor at 1-800-226-2370.

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