Lutein & Zeaxanthin: Protection Against Blue Light Damage to Eyes

By Gene Bruno, MS, MHS, RH(AHG)— Huntington College of Health Sciences

Lutein and zeaxanthin isomers (rr- and rs (meso)-zeaxanthin) are known as the macular carotenoids and well known for the role they play in supporting eye health. These carotenoid antioxidants are found in high concentrations in the part of the retina where age-related macular degeneration strikes,[1] and research suggests that lutein and zeaxanthin may have value in reducing the both the risk of macular degeneration[2] and cataracts.[3-5] The role that lutein and zeaxanthin isomers play in mitigating the effects of blue light on other types of common retinal damage that occurs every day, is not as widely known, but is critical.

Blue Light Explained

Blue light is the most energized component of visible light—and it surrounds us. Here's how it works. Upon passing through the lens of the human eye, the visible wavelengths of light (e.g. UV, blue) are focused upon the macular area of the retina. Of the wavelengths of visible light impinged upon the macula, the blue wavelengths penetrate deeply into the eye, and have the greatest potential to damage retinal tissue by inducing free radicals, etc.[6-9] It turns out that ongoing exposure to blue light (regardless of the source) is a major risk factor for various retinal pathologies.[10-13] Some research has evaluated the blue-light hazards from many different light sources and reported that the exposure to some of them, for even for less than a minute, is hazardous to the retina.[14] Furthermore, blue light is relatively ubiquitous. Sources include sunlight, digital devices (computers, tablets, smart phones, etc.) and artificial light, so it is hard to avoid.[15-20]

Blue Light Exposure and its Impact on Visual Function

So, how much blue light exposure does it take to result in eye damage, and what is the extent of that damage? Research indicates that headache, eye fatigue and other indications of eye strain are associated with the daily use of video display terminals on computers and other electronic devices, and are common with three or more hours/day of exposure; and such exposure is common. In fact, 30 percent of adults spend more than half their waking hours (more than nine hours) using a digital device, 50 percent of Americans use digital devices more than five hours a day and 70 percent use two or more digital devices at the same time.[21] This exposure to blue light is exacerbated by the fact that blue LED lighting is poised to increase by 800 percent in the next few years,[11] and 72.5 percent of adults are unaware of the potential dangers of blue light to eyes.[22] But the dangers are real and prevalent.

In one study[23] of 477 office workers, the following values of symptom prevalence were found in women and men, respectively: eye strain 50.7 percent and 32.6 percent, disturbed visual acuity 38.3 percent and 21.2 percent, mucosal dryness and eye burning 46.5

percent and 24.2 percent. Such visual health related symptoms in adults and children resulting from blue light digital exposure are now referred to as computer vision syndrome (CVS).[24] Not only that, but blue light exposure can also have negative effects on psychological stress and overall health, as well as sleep quality.

The Good News: Lutein and Zeaxanthin Isomers

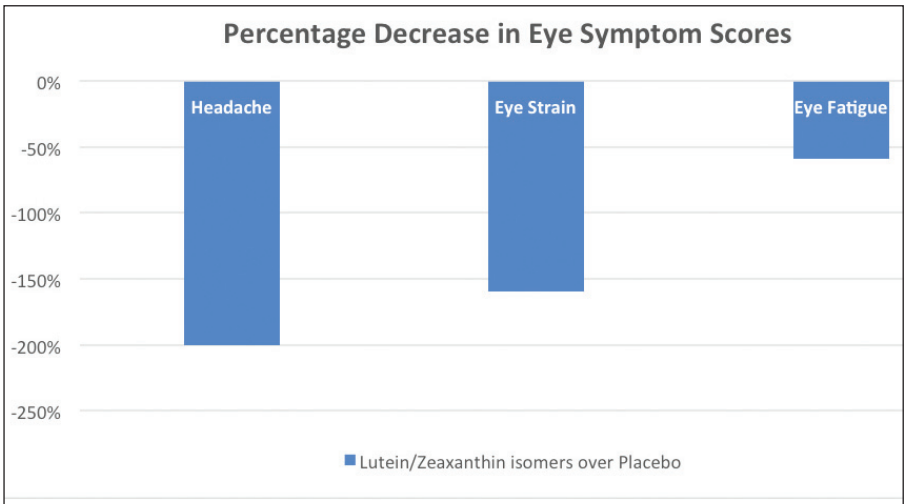
Now that you've heard the bad news about blue light and its damaging effects on the eyes, it's time for the good news. In short, supplementation with lutein and zeaxanthin isomers can provide substantial protection against blue light damage. In fact, that is arguably the major role that these carotenoids naturally play in the human body.

Of the more than 600 carotenoids found in nature, only lutein and zeaxanthin isomers (RR-zeaxanthin and RS (meso)-zeaxanthin) are located in the eye—specifically the macula. These yellow carotenoids make up the macular pigment; and the way in which they are deposited in the macula is highly specific: lutein is preferentially deposited in the peripheral macula, RR-zeaxanthin in the mid-peripheral macula and meso-zeaxanthin at the center of the macula, which is the region most susceptible to photo-oxidative damage. Because these carotenoids are yellow, they selectively absorb high-energy blue light, effectively protecting the retina from the region of the light spectrum that can cause tissue damage, and limiting the ability of light to generate free-radical oxygen and inflammation. Essentially, they act as primary filters of high-energy blue light. You might think of them as an internal pair of sunglasses for your eyes.

It should also be noted that the average U.S. dietary intake of lutein daily is less than 2 mg, and zeaxanthin is less than 0.5 mg. This is far below the 10-20 mg of lutein and 2-5 mg of zeaxanthin shown in research to be beneficial. Consequently, supplementation is a viable approach to maintain optimal levels of all three macular carotenoids to support visual health. Now let's take a look at human supplementation research on these carotenoids.

Eye Strain, Eye Fatigue and Headache

A study presented at ARVO (The Association for the Research in Vision and Ophthalmology) and conducted at the University of Georgia showed a relationship of exposure to blue light from digital devices and visual performance. They found that supplementing with lutein and zeaxanthin isomers (as Lutemax 2020 from OmniActive Health Technologies) reduced headaches, eye fatigue and eye strain:



Macular pigment optical density and visual performance

A double-blind, placebo controlled, 12-month trial[25-27] was conducted to assess the effects of lutein and zeaxanthin/meso-zeaxanthin (in a 5:1 ratio L:Z, as Lutemax 2020) versus placebo on macular pigment optical density (MPOD, a measure of the amount of the macular pigments lutein/zeaxanthin deposited in the macula), visual performance, total antioxidant potential and brain-derived neurotrophic factor (BDNF) in 60 subjects. Two levels of daily lutein supplementation were used: 10 mg (2 mg Z), and 20 mg (4 mg Z). The results were that:

- Both doses of significantly improved contrast sensitivity (CS) compared to baseline, and compared to placebo at 12 months.
- Both doses of significantly improved glare performance (i.e. excessive brightness, as might be caused by oncoming headlights at night) compared baseline, and compared to placebo at six and 12 months.
- Both doses of significantly improved photo stress recovery (i.e. a clinical procedure measuring the amount of time required for the macula to return to its normal level of function after being exposed to a bright light source) compared to baseline, and 20 mgL/4 mg Z improved photo stress recover compared to placebo at six and 12 months.
- Both doses of significantly improved MPOD compared baseline, and 20 mgL/4 mg Z improved photo stress recover compared to placebo at six and 12 months.

In addition, lutein/zeaxanthin improved levels of BDNF (a neurotrophin that is particularly active in hippocampus, cortex, and basal forebrain—areas that are involved in learning, memory, and higher cognitive processes). In this study,[28] the accumulation of lutein in the retina (MPOD) was assessed and compared to serum BDNF. Results showed that BDNF in lutein-supplemented subjects was found to significantly increase over the six-month study period ($p = 0.0243$), whereas the placebo group did not change ($p = 0.874$). This indicates that favorable response to lutein supplementation in the retina (and presumably the brain) leads to proportional increases in systemic levels of BDNF. Because neuro-inflammation has been shown to reduce BDNF levels, the anti-inflammatory capability of lutein is a plausible mechanism for this effect. In addition, lutein supplementation also enhanced antioxidant levels after six months compared to placebo.

Psychological Stress and Overall Health

The Nutritional Neuroscience Laboratory at the University of Georgia conduced a 12-week, double-blind, placebo-controlled trial[29] in 28 healthy subjects, to characterize the response dynamics in both blood and retina, for three different daily levels of lutein and zeaxanthin/meso-zeaxanthin (as Lutemax 2020) versus placebo. The

three doses of lutein were 6 mg (1.5 mg Z), 10 mg
(2 mg Z), and 20 mg (4 mg Z), versus placebo. Data regarding subjects' psychological stress and overall health status were also obtained. The results were that macular pigment optical density (MPOD) increased significantly in each of the lutein supplementation groups, compared to placebo, which exhibited little to no change throughout the trial. MPOD increased more as the lutein/zeaxanthin isomers dose increased, with greatest increases seen in those taking 20 mg of lutein. The increases in MPOD were also seen more quickly at higher doses, with significant increases occurring at 12 weeks for the 6 mg group ($p = 0.046$), but at eight weeks for the 10 mg and 20 mg group ($p < 0.001$). Another interesting finding was that those subjects with higher levels of MPOD tended to maintain a lower psychological stress profile ($p = 0.0087$). After 12 weeks of lutein supplementation, psychological stress levels were found to be reduced significantly. The placebo group did not change in this regard. Furthermore, those with higher MPOD tended to have fewer health-related problems (e.g. were sick less often, suffered less from allergies; $p = 0.002$). After 12 weeks of lutein supplementation, each group exhibited a significant reduction in health-related problems (6 mg: $p = 0.041$; 10 mg: $p = 0.029$; 20 mg: $p = 0.047$). Based on the results of this study, it appears that ingestion of the lutein supplements, at all three levels tested, produces significant response in the retina after only 12 weeks of supplementation. This is also the first study to show a relationship between lutein and psychological stress, and overall health.

Sleep Quality

So what's the connection between blue light, lutein/zeaxanthin and sleep? It's related to melatonin, a hormone, secreted by the pineal gland,[30] whose primary role is regulation of the body's circadian rhythm, and sleep patterns.[31,32] The way it works is that light, including blue light, inhibits melatonin secretion and darkness stimulates secretion.[33,34] Therefore, too much light exposure, particularly at night, can inhibit melatonin secretion and interfere with sleep. Research has shown that, at night, even blue light from smart phones can negatively impact sleep.[35] That's where blue-light filtering lutein and zeaxanthin isomers can help.

A two-part study[36] was conducted to determine if increasing participants' MPOD using lutein/zeaxanthin isomers supplementation would affect sleep quality. The first part was a three-month, double-blind, placebo-controlled trial with 45 healthy individuals. Those in the active supplement group ingested 20 mg lutein and 4 mg zeaxanthin isomers daily (as Lutemax 2020). Sleep quality was evaluated with the Pittsburgh Sleep Quality index (PSQI). Critical flicker fusion frequency (CFF) and contract sensitivity (CS) were also measured. Outdoor and indoor exposure to light (UV) and electronic devices before and after supplementation were recorded. Results were that the experimental group exhibited significant improvement in overall sleep quality ($p = 0.0063$) and MPOD ($p < 0.001$), as well as CS and CFF, at three months. There were no changes in the placebo group. This trial found that increasing MPOD via lutein/zeaxanthin isomers supplementation, might serve to absorb more blue light from sources (such as computer screens, tablets, or smartphones) that can be used during nighttime hours, and would otherwise provide a circadian signal to stay awake.

The second part was also a six-month, double-blind, placebo-controlled trial in which 34 healthy individuals participated. The same supplementation regimen and assessment methods were used as with the three-month study. Results were that at six months MPOD, CFF, CS, sleep quality improved with lutein/zeaxanthin supplementation, with no changes in the placebo group.

Conclusion

Blue light from sunlight, digital devices and artificial light represent a heretofore unknown, but serious risk for promoting damage to retinal tissue, which in turn may increase the risk of macular degeneration, cataracts, eye strain, eye fatigue, headache, visual impairment, psychological stress and poor sleep quality. However, clinical research has shown that daily supplementation with lutein (10-20 mg) and zeaxanthin isomers (2-4 mg) can mitigate these risks and support eye health even after they have manifested. **VR**

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Gene Bruno, MS, MHS, the dean of academics for Huntington College of Health Sciences, is a nutritionist, herbalist, writer and educator. For more than 30 years he has educated and trained natural product retailers and health care professionals, has researched and formulated natural products for dozens of dietary supplement companies, and has written articles on nutrition, herbal medicine, nutraceuticals and integrative health issues for trade, consumer magazines and peer-reviewed publications.
He can be reached at gbruno@hchs.edu.

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physical and environmental stressors.

Bluebonnet rounds out its weight-management supplement category with thermogenic Standardized Cayenne Pepper Fruit Extract Vegetable Capsules and Standardized EGCG Green Tea Leaf Extract Vegetable Capsules. They may increase energy expenditure by stimulating thermogenesis and counteracting the decrease in metabolic rate that occurs during weight loss. The company also offers L-carnitine (500 mg) an amino acid that produces energy from fat, and conjugated linoleic acid (CLA). "When combined with a balanced diet and exercise, Clarinol CLA has been shown in clinical research within eight to 12 weeks to help reduce body fat, build lean muscle, and improve overall body shape," Weinhardt noted.

Genesis Today's weight management products, said Brucker, address one or more of the following pathways: appetite control, blood sugar management, energy and metabolism, and mood support. Sustained weight management should be addressed from a holistic, 360 approach. Its Nature Trim 5 is a multi-dimensional formulation that targets each of these aspects (appetite control, blood sugar, energy/metabolism, and mood support). The company's Garcinia Cambogia formula combines black pepper and chromium to enhance metabolic function.

Genesis Today recently debuted a new product to its weight-management portfolio called FitTrim, which features CardiaSlim. "CardiaSlim is a unique plant-derived ingredient that has been shown in double-blind, placebo-controlled clinical studies to support healthy triglyceride levels and promotes weight loss without the use of any harsh stimulants," Brucker explained.

No matter what supplements your customer who is actively losing weight uses, the dreaded plateau often interrupts, and this period when the body is basically taking a rest is natural but not welcomed because it is not well understood by consumers and it often causes the person to give up. Here, patience is definitely the virtue, and the long-range health and well-being benefits are the rewards. **VR**

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