Macular Supplements for Optimal Vision Across the Life Cycle

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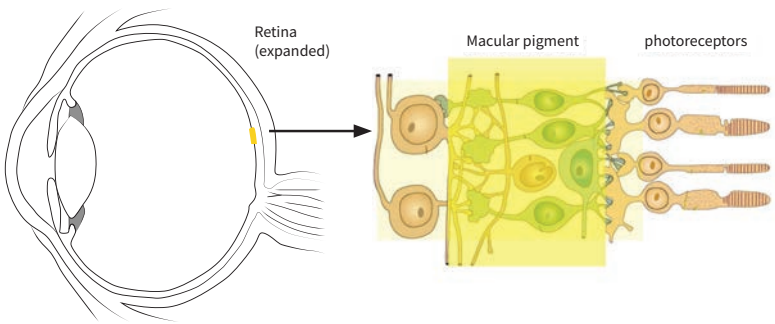
The idea that a select few dietary nutrients could 1) be crucial for normal retinal development, 2) enhance visual performance throughout life, and 3) help reduce the risk of developing age-related eye disease might at first seem preposterous. However, a wealth of recent evidence substantiates these roles for lutein (L), zeaxanthin (Z), and mesozeaxanthin (MZ).

L and Z are naturally-occurring carotenoid pigments found primarily in leafy-green vegetables, such as spinach and kale.[1] They are not synthesized by the body and so must be obtained from dietary sources or supplements. Those who have diets rich in leafy greens or supplement with sufficient L and Z tend to have higher blood and tissue concentrations of these carotenoids.[2,3] Although somewhat rare, MZ is present in the diet in various parts of the world—it is found in 21 species of fish, including trout flesh,[4] shrimp and sea turtles, as well as eggs (due to supplementation of chicken feed) in California and Mexico.[5,6] Importantly, MZ has been shown to be converted from L in the retina; it is found in high densities in the very center of the retina, where it affords protection and performance to the vulnerable neural tissue there. In terms of dietary response, MZ is readily deposited in the retina when taken in supplement form.[7,8]

L, Z, and MZ serve very important functions in the body. First, they are extremely potent antioxidants. L, Z, and MZ's antioxidant capability enables them to protect bodily tissues against damaging free-radical oxygen.[9] This is an extremely important function, because if free-radical reactions continue unabated they can lead ultimately to tissue degeneration, DNA damage, or in some cases, cancer. This is especially true for tissues with extremely high metabolism such as the macular retina, where the antioxidant potential of L, Z, and MZ is crucial for maintaining health and function. Secondly, L, Z, and MZ protect the vulnerable macula by absorbing high-energy, short-wavelength light. Their collective yellow-orange coloration and deposition in the macular region of the retina can be seen with ophthalmoscopic examination and has led to the term "macular pigment." This pigmentation effectively acts as a short-waveband filter, which further protects the macula from the cumulative damage that can manifest as age-related macular degeneration (AMD).[10]



Macular Pigment and Visual Performance The yellow macular pigment is most dense in the fovea, and is anterior to the photoreceptors; this enables pre-receptoral filtration of short-wavelength light, and mediates several positive effects on visual performance.
Image: James M. Stringham, PhD

We often fail to appreciate the high-energy, somewhat violent nature of the chemistry of our body; in some cases the body's endogenous antioxidant systems are no match for the assault. For this reason, the body supplements endogenous defense systems with nutrients via diet, and builds a defense against oxidation in key areas such as the retina and brain, where it is most needed. With regard to L, Z, and MZ, this preferential placement in vulnerable tissues starts very early.

The Macular Carotenoids in the Womb / Infancy / Childhood

Until fairly recently, the role of L, Z, and MZ in health was thought to be limited to helping protect against the development of AMD in one's senior years.[11] Ironically, however, over the last 10 to 15 years, solid evidence from prenatal and neonatal research indicates an important role for these carotenoids in the *start* of life. Recently it was determined that L & Z are the dominant carotenoids found in the placenta.[12] Surprisingly, these levels were not correlated with the mother's current diet. This is suggestive of long-term storage of these crucial carotenoids in the adipose tissue of women until pregnancy, whereby release of L & Z appears to occur. These findings are illustrative of an apparent prioritization of L & Z in terms of gestational development and health. This prioritization can be seen beyond the placenta, where it has been shown that L and Z play a major role in the early development of neural tissue in utero.

At about 6 weeks of gestation (before the retina starts to develop), L and Z are transferred via the umbilical cord[13] from the mother to the fetus and start to accumulate in an ocular reservoir called the vitreous humor. At week 20 of gestation, as the retina begins to be "built," L and Z are diverted from the vitreous humor into the now-forming retinal tissue, where they serve as antioxidants during the volatile, highly metabolic environment of neurogenesis and synaptogenesis.[14] Because oxygen is one of the major fuels for metabolism, the potential for free-radical oxidative stress and damage is high; based on the conspicuous timing of passage from the vitreous humor to the retina, coupled with the antioxidant capability of L and Z, it is not unreasonable to suggest that they play a crucial, early role in the protection and development of neural tissues. Additionally, because much development in the retina occurs after birth, L, Z, and MZ undoubtedly maintain this role well into childhood.

In fact, an argument could be made that children, despite their relatively small stature, actually need as much or more daily L, Z and MZ as adults. This is for two reasons: 1) Children are still developing and are thus using more oxygen to build tissues. More oxygen leads to increased potential for oxidative stress, and L, Z, and MZ can help to reduce it. 2) Tissue stores of L, Z, and MZ (such as the retina, brain, and adipose tissue) in children are relatively empty. By ensuring that a meaningful amount of these carotenoids is included in a child's diet, accumulation in these critical areas of the body is promoted. This would ultimately lead to enhanced protection into adulthood and beyond.

Lutein, Zeaxanthin, and Mesozeaxanthin in Adulthood / Old Age

In adults, L, Z, and MZ status in the retina (macular pigment) is associated with several notable visual performance advantages, including increased visual processing speed,[15,16] contrast sensitivity,[17-19] and better vision in dim lighting conditions.[20,21] Additionally, several studies have determined enhanced visual performance in glare, including reduced discomfort, faster photostress recovery time, and decreased disability glare.[22-25] Importantly, each of the performance parameters noted is *modifiable* via supplementation with L, Z, and MZ.[17]

Lastly, there is a well-established relationship between high concentrations of macular carotenoids and a reduced risk for developing AMD, a leading cause of vision loss in people over 50 in the United States. Importantly, there is evidence that even after the onset of AMD symptoms (e.g., mild distortions of central vision), macular carotenoid supplementation can slow down, or even stop progression of the disease.[19,27] It appears, therefore, that the macular carotenoids have not only long-term protective effects on tissues, but also acute benefits as well.

Given all of the existing research, L, Z, and MZ appear to provide meaningful, significant benefits across the lifespan. The more we learn about these carotenoids, the more apparent it becomes that they are crucial to normal development, health, and performance. From their early involvement in protecting developing neural tissues to reducing cumulative damage that results in age-related disease later in life, it is clear that L, Z, and MZ are meant to play a significant role in optimizing human development, performance, and aging. Importantly, supplementation with MacuHealth with LMZ3 will help augment the sometimes low dietary intake of these nutrients throughout life. Although L, Z, and MZ are not considered essential nutrients (i.e., vitamins), based on the available scientific evidence, they may certainly be considered essential for peak health and performance.

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