



# IMAGE AWARENESS WELLNESS INSTITUTE

## Carotenoids

1271 HIGH STREET, AUBURN, CA 95603 • PHONE (530) 823-7092 • ORDER LINE (800) 359-6091  
HOURS: TUES. – FRI. 10 A.M. – 4 P.M. • E-MAIL: MAIL@IMAGEAWARENESS.COM WEB: WWW.IMAGEAWARENESS.COM

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### CAROTENOIDS

Carotenoids are the *fat soluble* coloring pigments found in fruits and vegetables. They are usually yellow, orange, or red. Carotenoids have been referred to as “nature’s crayons.” The carotenoids in leafy green foods are hidden by the dark green color of chlorophyll. In the fall when cold weather kills the chlorophyll we see the carotenoids in leaves become visible resulting in the beautiful fall colors we are familiar with. Carotenoids are the complement of the water-soluble flavonoids found in foods.

Carotenoids are powerful antioxidants. When we consume them in foods or in supplement form they have the *ability to neutralize free radical oxygen* which can damage cellular structures such as the cell wall and DNA.

Superactivated oxygen can be found in the air we breathe, the water we drink and the food we eat. The greatest source of exposure to free radical oxygen, however, is within the mitochondria where the body burns calories to produce energy. Roy Walford writes, “All the ingredients for massive free radical oxidation are present in living cells. Cells are impregnated with iron and other metal complexes, drenched in oxygen, enveloped in and shot through with highly unsaturated fats and oils. We would instantly set solid if these became saturated, as they do and we do in rigor

mortis, and as we would do if we were not protected by our scavengers.”

#### REFERENCE:

Walford, Roy, *Maximum Lifespan*, New York: W.W. Norton & Co., 1983, 133-135.

### RELATIVE STRENGTH OF CAROTENOIDS

- Lycopene
- Gamma-carotene
- Astaxanthin
- Canthaxanthin
- Alpha-carotene
- Beta-carotene
- Bixin
- Zeaxanthin
- Lutein
- Tocopherols
- Thiols

Above is a list of the most powerful free radical oxygen quenchers listed in order of their antioxidant capacity. All of the compounds with the exception of the tocopherols (vitamin E) and thiols (cruciferous compounds) are carotenoids. Carotenoids

are a very important protective mechanism of tissue structures in the body.<sup>1</sup>

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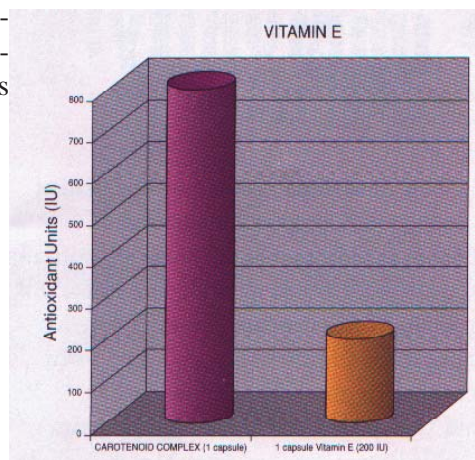
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### SPECIFICITY OF ACTION

Carotenoids are not interchangeable for one another. They often have very specific functions which are highly significant and one often finds that other nutrients can not perform this function as efficiently.

#### Lutein

An example is lutein and zeaxanthin. These carotenoids play a very special role in the protection of the back of the eye called the macula lutea where sunlight focuses when we are outdoors. Over a lifetime, the sunlight focusing in this small area can damage the area involved with sight resulting in the disorder called



macular degeneration. The result is a blind spot in the middle of the visual field. In one study those with the highest carotenoid intake had a 43% lower risk of developing age-related macular degeneration (AMD) than those with the lowest intake.

Richard Young, Ph.D., a member of the Jules Stein Eye Institute, summarizes the importance of the xanthophylls (lutein and zeaxanthin):

“The xanthophylls appear to have the triple function of (1) absorbing violet/blue light before it can damage the visual cells and retinal pigment epithelium (the cells which deteriorate in AMD), (2) acting as retinal antioxidants, and (3) being situated in just the right place for protection against AMD—front and center in the retina.”<sup>1</sup>

Lutein and zeaxanthin are found primarily in leafy green foods including kale, collards, spinach, Swiss chard, mustard greens, and beet greens. Higher intake of spinach and collards in particular is associated with lower risk of AMD. Unfortunately, most people eat few of these foods.<sup>2,3</sup>

Lutein and zeaxanthin are also the primary carotenoids involved in protecting the skin when it is exposed to ultraviolet light.<sup>4</sup> This is highly significant in view of recent research which has shown that vitamin D, the sunshine vitamin, protects against osteoporosis, a variety of cancers, boosts immune function, regulates blood sugar, and inhibits autoimmune diseases. Unfortunately, many individuals do not tolerate sunlight exposure or risk increased skin cancer when they do spend time in the sun because of inadequate intake of the carotenoids found in leafy green foods.

#### ASTAXANTHIN

Astaxanthin, another carotenoid, protects the mitochondria, the energy factory of the cell. This is a critical area for antioxidant activity in the body since large quantities of free radical oxygen is gener-

ated when the body produces energy.<sup>5</sup>

#### BETA-CRYPTOXANTHIN

Intake of another carotenoid called beta-cryptoxanthin was found to be 40% less in those who developed inflammatory arthritis than in those free of the disease. Blood levels of this carotenoid also appear to reduce the risk of lung cancer in smokers.<sup>6,7</sup>

#### LYCOPENE

Lycopene, the red carotenoid pigment found in tomatoes and watermelon has been shown to concentrate in the testes, prostate, and the adrenal gland. Lycopene has been shown to prevent cancer and heart disease.

Studies have not shown a correlation of most carotenoids with reduced risk of prostate cancer, but lycopene reduced total prostate cancer risk by 35% and the risk of aggressive prostate cancer by 53%.<sup>8,9</sup>

#### ALPHA-CAROTENE

Alpha-carotene appears to be among the most powerful anti-cancer compounds in the carotenoid family. In an N-myc gene model of cancer growth alpha-carotene was shown to shut down cell growth at levels as low as 2 to 5 micromoles and proved toxic at a level of 10 micromoles. Within 3 hours alpha-carotene reduced N-myc activity, which codes for cancer cell growth, by 24% and within 18 hours activity had dropped to 18% of that in untreated cells. The researchers wrote, “alpha-carotene apparently inhibits cancer growth by locking malignant cells in the rest phase of their growth cycle. And they remain in this sort of suspended animation until the effects of the carotenoid begin wearing off.” The effects of alpha-carotene begin wearing off after 18 hours. Beta-carotene could pinch-hit for alpha-carotene in this activity, but is was ten times less effective than alpha-carotene.<sup>10</sup>

#### MORE EXAMPLES

Examples of carotenoid specificity can be multiplied. The carotenoid bixin has been shown to cause regression of virally induced tumors in animals.

Phycotene increases activity of T cells and macrophages in tumor models.<sup>11</sup>

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## COMPETITIVE ABSORPTION

The phenomenon of competitive absorption is rarely considered when formulating supplementation with carotenoids. The first research on this phenomenon with regard to a fat soluble nutrient was the work of Stephan Christen with the vitamin E family of nutrients. Christen found that large doses of alpha-tocopherol displaced gamma-tocopherol in the blood and other tissues. Gamma-tocopherol blocks the activity of mutagens which contain nitrogen in a manner which alpha-tocopherol does not.<sup>1</sup> It has been suggested that supplementation with a



large quantity of a single carotenoid may similarly inhibit the absorption and functioning of other carotenoids.<sup>2</sup>

A secondary issue with regard to unbalanced carotenoid formulas is the source of the carotenoids. Synthetic beta-carotene can be manufactured from acetylene gas. This form of carotenoid has failed to show benefit in the CARET (Beta-carotene and Retinol Efficacy Trial) and Physician's Health Studies. A common form of beta-carotene used in supplements and testing is called Lurotin, manufactured by BASF, a huge German chemical company. This form of beta-carotene is manufactured from acetylene gas and bears no resemblance to natural beta-carotene.<sup>3</sup>

Another common source of carotenoids is *Dunaliella salina*--a pink algae which grows in sea salt fields. High levels of carotenoids are produced as a protective mechanism against bright sunlight. This source of carotenoids is superior to the acetylene gas derived synthetic product, but does not derive from foods which would normally be eaten and does not contain an optimal profile of carotenoids.

The safety of algae products from fresh water sources has been questioned by Wayne Carmichael, an aquatic toxicologist, who wrote, "... the toxicity of many chemicals produced by cyanobacteria is undeniable. For this reason, I am becoming increasingly worried by a modern fad:

the eating of cyanobacteria from the genus *Spirulina* as a health food.... there are no guidelines requiring those marketing *Spirulina* to monitor their products for contamination by potentially toxic cyanobacteria or by cyanobacterial toxins."<sup>4</sup>

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2. "Beta carotene pills:should you take them?" *University of California at Berkley Wellness Letter*, Vol. 12, Issue 7, April 1996, p. 1.
3. <http://www.whale.to/a/barron1.html>. Lurotin is 100% all-trans-beta-carotene while food sources of beta-carotene are a combination of all-trans-beta-carotene and 9-cis-beta-carotene. The natural form of beta-carotene has superior antioxidant properties. Ben-Amotz, A., and Levy, Y., Bioavailability of a natural isomer mixture compared with synthetic all-trans beta-carotene in human serum, *American Journal of Clinical Nutrition*, 63, 729-734.
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#### SYNERGISM

Nutrients work together as described by the following quote: "The scheme the chemists propose works something like a bucket brigade, with the dangerous chemical property being passed from one molecule to the next. First, vitamin E reacts with the free radicals, restoring them to their less harmful state. This reaction, however, turns vitamin E into a potentially damaging free radical, which the carotenoids then inactivate. Finally, vitamin C repairs the resulting carotenoid radicals, and the water soluble vitamin C radicals eventually wash out of the body."<sup>1</sup>

The synergism of nutrients reveals one of the flaws of medical testing on nutrients. The first thing researchers often do when testing nutrients is to have subjects discontinue all supplements they are taking.

#### REFERENCE:

1. W., C., "How antioxidants defend cells," *Science News*, Vol. 151, February 15, 1997, p. 111.

## THE CAROTENOID GAP

Americans do poorly in consumption of these important protective nutrients. Recommended intake of fruits and vegetables is a minimum of five servings a day. Many of these foods have little or no carotenoid content. America's most popular fruits and vegetables — apples, oranges, iceberg lettuce, potato and corn — are not good sources of carotenoids.

Only about one person in 10 consumes five servings of fruits and vegetables in a day. Average intake of carotenoids is only about 25% of what is considered desirable.<sup>1</sup>

Daily intake of carotenoids is important. "The blood level of carotenoids is primarily regulated by ingestion: as we ingest more carotenoids, the blood level increases."<sup>2</sup>

In addition to quantity of intake, variety of intake also appears to confer greater benefits. One researcher writes, "The most surprising result indicates that routine consumption of all the vegetables listed on the study questionnaire offers stronger protection (against cancer) than consumption of any one kind of vegetable or nutrient. 'That suggests to us that we need to look at the additive and interactive effects of these [vegetable] components.'"<sup>3</sup>

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## CAROTENOID COMPLEX

GNLD's carotenoid product grew out of years of research. The initial step in development involved developing testing to identify the presence of specific carotenoids in foods and in the blood. Examination of carotenoid containing foods revealed dramatic differences in the carotenoid content of different foods. Levels even varied





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within a food category. Some spinach had 100 times more lutein than other spinach products. At this step of development GNLD was interested in putting together a product with an ideal carotenoid profile which would provide all the specific benefits suggested by the specificity of action of the different types of carotenoids.

The next step in developing a carotenoid product involved putting the carotenoids in a supplement. This posed a couple of problems. Firstly, carotenoids are readily destroyed by light and by oxygen. GNLD developed the Nutri-Max process which involves handling the raw materials in a nitrogen environment to maximize the potency of the resulting product.

A second problem involved optimizing the absorption of the carotenoids. In nature, carotenoids are tightly bound to fiber and poorly absorbed. GNLD blended the carotenoids in olive oil to improve absorption of these fat soluble nutrients. Testing was conducted demonstrating that the supplement when taken as suggested (3 capsules a day) elevated blood levels of carotenoids above levels found in many individuals consuming typical American diets.

Dr. Richard Cutler found that blood levels of carotenoids were associated with life span in both men and animals.

At this point, the United States Department of Agriculture, interested in the nutritional benefits of carotenoids, requested some of the supplement GNLD had developed. They were motivated by the testing which demonstrated effective absorption of the carotenoids in the product.

Department of Agriculture testing showed that the Carotenoid Complex had the ability to increase lymphocyte proliferation by 37%. This is the ability of one of the body's key immune defenders to reproduce. The supplement also increased natural killer cells by 20%. These immune cells are central to the body's response to cancer. Supplementation also increased the antioxidants in cholesterol five-fold, presumably decreasing the risk of oxidation of cholesterol which is a starting point for the development of heart disease.

Finally, Carotenoid Complex reduced oxidative damage to the cells by 44%. Oxidative damage at the cellular level contributes not only to disease, but can also play a role in the aging process.<sup>1</sup>

The Carotenoid Complex is patented: 2,274,235 UK.

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