

Review on Importance of Carotenoids in health and medicine

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Abstract

Carotenoids are among the most common natural pigments which play a major role in the protection of plants against oxidative damage and also acting as attractants for pollinators. More than 600 different compounds have been characterized and the major types of carotenoids that are used commercially in the international market are β -carotene, astaxanthin, lutein, canthaxanthin, lycopene, and zeaxanthin. Carotenoids are products of the isoprenoid biosynthetic pathway. The carotenoids are essential as antioxidants, natural colorants, pharmaceuticals and nutraceuticals. It has been confirmed that carotenoids inhibit the commencement of numerous disorders such as multiple sclerosis, arteriosclerosis, cataract, age related macular degeneration, cancer and arthritis. They also exhibit anticancer, anti-aging and immune modulatory activities. The demand of carotenoids has triggered the research to explore a commercial viable process for economic production of carotenoids. Number of ongoing studies investigating the use of carotenoids to enhance healthcare and beauty but most of these studies have been carried out in animal models, with very few human clinical trials. Therefore future areas of research will need to focus on human clinical trials.

Keywords- *Anticancer; Antioxidants; β -carotene; Carotenoids; pharmaceuticals*

Introduction

We are nothing without pigments. Life represent kaleidoscope of colors. From the green grass of home to a forests ruddy autumn hues, we are surrounded by colorful Environment. Living things obtain their colors, with few exceptions from natural pigments. Natural pigments carry out a variety of important biological functions (1). 'Carotenoids' is a generic term used to designate the majority of pigments naturally found in animal and plant kingdoms. Carotenoids are a class of

compounds that have coloring power and have been widely used in food industry, leading its market to full development (2). Carotenoids occurs widely in nature, in all fruits and vegetables of color are good source of these compounds, and only a few have been available commercially including beta carotene, lycopene, astaxanthin, canthaxanthin and lutein. They are recognized as playing an important role in the prevention of human diseases such as cancer, cardiovascular, age-related macular degeneration, neurodegenerative diseases. They also exhibit medicinal properties such as pro-vitamin A,

antioxidant/ pro-oxidant, and anticancer. The growing demand of carotenoids has triggered the development of carotenoids rich food products with nutraceutical properties for additional health benefits (3).

Classification

Depending on the presence or absence of oxygen in the molecule, they can be divided into: 'xanthophylls' (which contain oxygen) from greek words xanthos, meaning yellow, and phyllon, meaning leaf. Such as bixin lutein lycophyll and many more and carotenes (which are purely hydrocarbons, and contain no oxygen). Such as zeta -carotene, alfa- carotene, and beta- carotene. All are derivatives of tetraterpenes, meaning that they are produced from 8 isoprene molecules and contain 40 carbon atoms.

Carotenoids and Their Medicinal Properties

1. Carotenoids as provitamin A: Carotenoids activity of provitamin A has been known for a long time (4).more than 600 natural carotenoids have been identified (5). out of them approximately 700 carotenoids found in nature , only about 50 shows provitamin A activity(6).among them , only three are most important precursors of vitamin A in humans: alpha carotene , beta carotene , andbeta cryptoxanthin (7).which are converted into vitamin A in the body . Beta carotene is the vital Provitamin A element of almost all carotenoid – containing foods and is found fruits and vegetables. This compound is progenitor of vitamin A. which is excellently known to have the caliber of

suppress serious eye diseases, such as night blindness (8).

2. Carotenoids as Antioxident / Pro-oxidant: In all organisms, carotenoids can functions as antioxidants and enhance oxidative stress resistance (9). In the human organism, carotenoids are part of antioxidant defense system .carotenoids can put out single oxygen in similar manner to tocopherols. Carotenoids, as well as, and tocopherols are known to be cost-efficient antioxidant and caliber of scavenging reactive oxygen species generated during photo-oxidative stress. Moreover, carotenoids can scavenge oxidizing free radicals via at least three primary reactions, by its addition, electron transfer, addition and hydrogen atom transfer. They are also unable to react directly with superoxide and other free radicals. Carotenoids may form resonance- stabilized carbon- centred radicals, for example by reaction with lipid peroxyradical .lycopene may function as an antioxidant (10).

3. Carotenoids as anticancer: Worldwide, about 10 million cancer diagnoses occur each year, and the number is rising speedily. It has been estimated that if people were to eat plant – based diets rich in a variety of fruits (papayas, mangoes , apricots, legumes, and peaches) and vegetables (tomatoes, carrots, broccoli, squash, and sweet potatoes) and lowest processed starchy staple foods each day, so the comprehensive cancer rates could decline by as much as 20%(11) . A scientifically supportable low-risk strategy that would enable the potential effects of carotenoids, a diet that includes a sufficient amount of fruits and vegetables, including those that are rich in carotenoids (11).

Health Benefits of Carotenoids

Carotenoids are beneficial antioxidants that can protect you from disease and enhance your immune response. Provitamin A carotenoids can be converted into vitamin A, which is essential for growth, immune system function, and eye health. Recent interest in carotenoids has been stimulated by epidemiological studies that strongly suggest that consumption of carotenoids rich foods reduces the incidence of several diseases such as cancers, cardiovascular diseases, age related macular degenerative diseases (12). Independent of nutritional capacities, the carotenoid that contain nine or more conjugated double bonds can inactivate certain reactive oxygen species, such as singlet oxygen. The long system of alternating of double and single bonds common to all carotenoids allow them to absorb light in the visible range of spectrum. This feature has particular relevance to the eye, where lutein and zeaxanthin efficiently absorb blue light, reducing the amount of blue light that reaches the structures of the eye that are critical to vision may protect them from light induced oxidative damage. There have been many reports over the year of a positive effect of dietary or supplemental carotenoids on improving fertility or reproductive capacity in a number of animals.

Carotenoids in Immune Response

Beta carotene and other carotenoids have been reported to possess immunomodulatory activities in human and animals. These carotenoids enhance lymphocyte blastogenesis, increase the population of specific lymphocyte subsets, increase lymphocyte cytotoxic activity, and stimulate the production of various cytokines. There is growing evidence from

in vitro and in vivo laboratory animal studies that beta carotene can protect phagocytic cells from auto oxidative damage, enhance T and B lymphocytes proliferative responses, stimulate effector T cell functions, and enhance macrophage, cytotoxic T cell and natural killer cell tumoricidal capacities, as well as increase the production of certain interleukins. A recent study in HIV infected women reported lower serum concentrations of lycopene, alpha carotene, and beta carotene, especially in those with low counts of CD-4 helper cells. Both beta carotene and selenium are deficient in a significant percentage of both HIV and AIDS patients. Their role as antioxidants in HIV/AIDS appear to be related to both direct immune modulation and inhibition of cytokine and NF-KB activation, inhibiting HIV replication. Beta carotene has been shown to act directly as an immunomodulatory by increasing natural killer cell function and improving CD4 count. As an antioxidant, beta carotene appears to support enzymatic defense systems involved in minimizing oxidative damage.

Carotenoids in Human Macula

Three dietary carotenoids – lutein, zeaxanthin, and mesozeaxanthin form the pigment in the macula (macular pigment) that protects the millions of photoreceptor cells located in this small region of the central retina. Eating carotenoid rich foods can protect the healthy cells in the eye and prevent the growth of cancerous cells. One of the leading cause of blindness is macular degeneration, or the degeneration of the cancer of the retina. Long term blue light exposure can cause this and negatively affect the delicate parts of the eye. However, the carotenoids lutein and

zeaxanthin found in the retina can help to absorb blue light. Recent studies show that incorporating at least six milligrams of lutein in your diet a day can decrease your risk of developing macular degenerative by 43 percent. Increasing the amount of lutein and zeaxanthin in your diet can also help to slow or halt current eye damage, and prevent your current condition from progressing.

Carotenoids in Cardiovascular Disease Prevention

Cardiovascular disease (CVD) is the main cause of morbidity and mortality in developing society. Antioxidant compounds found in fruit and vegetables, such as vitamin C, carotenoids, and flavonoids, may influence the risk of CVD by preventing the oxidation of cholesterol in arteries. Carotenoids are antioxidants, lowering inflammation in the body. Though it's still being researched, carotenoid anti-inflammatory properties have been associated with improving cardiovascular health. Reducing inflammation helps to protect against heart disease and prevents arterial walls from being blocked. Vegetables and fruits represent important sources of carbohydrate, dietary fiber, antioxidant vitamins, minerals, polyphenols, and various phytochemicals and, in particular, they are the main assets of carotenoids in the human diet (13-14). Cardiovascular Disease (CVD) stays a significant reason for grimness and mortality in created society. Since oxidative pressure and aggravation are key players in the Etiology of CVD, it is possible that common cancer prevention agents, for

example, carotenoids, existing in products of the soil, may help in forestalling the CVD beginning.

In excess of 700 carotenoids have been recognized, among them β -carotene, α -carotene, β -cryptoxanthin, lutein, lycopene, and zeaxanthin are the significant dietary carotenoids with cell reinforcement properties likely connected to the capacity in rummaging free radicals, for example, lipid peroxy radicals, receptive oxygen species (ROS), and nitric oxide (NO). Expanded ROS age has been related with a practical inactivation of NO because of the response with superoxide anion (O_2^-), prompting peroxynitrite (ONO_2^-) arrangement and ensuing decrease in vascular NO bioavailability that portrays the beginning period of atherosclerosis.

Carotenoids, at any rate to some extent, by legitimately expelling O_2^- , have been appeared to reestablish NO endothelial bioavailability. Subsequently, they might be viewed as potential enemy of oxidant modulators of endothelial reaction to genius oxidant/incendiary boosts.

All the more as of late, a few in vitro and in vivo analyzes have shown that carotenoids can diminish irritation and oxidative worry through the guideline of different cell capacities, consequently supporting the epidemiological examinations demonstrating a solid connection between dietary carotenoid utilization and diminished danger of CVD. Be that as it may, since human mediation considers are dubious, the in vivo instrument/s hidden the carotenoid's cardiovascular defensive exercises is still minimal known.

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