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AGING SLOWS DOWN WITH ANTIOXIDANTS:
IS IT POSSIBLE?

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ABSTRACT

We have excess mortality in many countries, which also affects younger people with no known previous diseases. From this point of view, it seems reasonable to look for life-prolonging methods. According to current knowledge, one of the main factors is the neutralization of oxidants and free radicals. For this purpose, there exist a set of natural means known as antioxidants. This article presents three of them, which have been proven to have a strong effect in preventing diseases and prolonging life. They are: C60 fullerenes, astaxanthin, and glutathione. Their regular intake can be recommended.

KEYWORDS

Longevity, antioxidation means, free radicals, disease prevention, life prolongation.

INTRODUCTION

Antioxidants play a crucial role in the phenomenon of "anti-aging" within biological systems. To comprehend this connection, it is necessary to understand how aging processes occur in the body. Aging processes are partly caused by unstable molecules known as free radicals, which have an unpaired electron, making them highly reactive. These free radicals can bind to other molecules in the body, causing damage. Moreover, the molecules that lose an electron in this process become free radicals themselves, leading to an accumulation of cellular damage over time. This damage can affect cells, tissues, and organs, ultimately resulting in age-related changes and diseases. Reactive oxygen species (ROS) are particularly significant stressors for cells, especially the mitochondria, leading to changes in RNA and DNA within the mitochondria (mitochondriopathy), which require repair by specialized enzymes.

This is where antioxidants come into play. Antioxidants are molecules capable of neutralizing free radicals by providing the missing electron without becoming unstable radicals themselves. This process is termed "antioxidant defense." By neutralizing free radicals, antioxidants effectively reduce oxidative stress in the body, thereby protecting cells and tissues from damage.

As we age, the body's antioxidant defenses naturally decrease, and oxidative stress tends to increase. This process is one of the contributing factors to the natural aging process. Uncontrolled damage caused by free radicals can lead to premature aging, reduced cellular function, and an elevated risk of age-related diseases.

By incorporating antioxidants into our diet through food or supplements, we can better protect our bodies from oxidative stress. By ensuring our bodies have adequate antioxidants, we can help minimize cellular damage and slow down the aging process. Below, we present three highly powerful antioxidants:

C60 Fullerene - A Very Special Carbon

Fullerenes are a group of spherical molecules that, along with graphite and diamond, represent another modification of pure carbon (15,16). The primary occurrence of fullerenes is found in schungite, a mineral mainly composed of carbon. This mineral is said to possess the most extraordinary properties, and responsible for these properties are the fullerenes. Schungite has been extensively researched for its mode of action in Russia and has been used for centuries. Particularly interesting in this context is the so-called "Baatistudy" (17).

Since fullerenes are difficult to dissolve, we dissolved them in apricot kernel oil, which proves to be a much better solvent than olive oil or other oils.

The molecule C60, also known as fullerene 60 or buckyball, consists of 60 carbon atoms arranged in the shape of a small soccer ball with a diameter of 1.1 nanometers. C60 is one of the most stable carbon compounds due to its highly symmetrical arrangement (18).

In 2012, a Paris study caused a stir in the scientific community when the lifespan of experimental rats nearly doubled with the administration of C60 dissolved in olive oil. The average lifespan of a Wistar rat is approximately 22-28 months, but the first rat fed C60 oil did not die in the experiment until 58 months, and the last rat was then euthanized after 66 months due to time constraints to complete the study (17). All rats fed C60 in olive oil lived at least 20 months longer than the longest-lived rat in the

water-treated control group. When converted into human years, this would equate to a gain of more than 60 years, added to the average lifespan of 79 years in industrialized nations.

C60, or Buckminsterfullerene, is a carbon modification that was first synthesized in 1984. The structure of C60 is reminiscent of Buckminster Fuller's geodesic dome, hence the name. The C60 sphere consists of 12 pentagons and 20 hexagons linking the 60 carbon atoms in the molecule, giving it the same structure as a soccer ball, which explains its nickname "buckyballs."

The molecule has been found to occur naturally in space and in stardust. It has also been detected in ancient mineral deposits and meteorites located on Earth. Every time coal is burned, a very small amount of C60 is also produced, indicating that the human organism has had physiological contact with the molecule for thousands of years, albeit in very low doses.

On one hand, the molecule is able to inactivate hydroxyl radicals, and on the other hand, it can absorb protons, giving it a slightly positive charge. This makes it a potent radical scavenger inside the mitochondria. C60 donates the protons from its interior to the radicals, thus neutralizing them. Another antioxidant effect is caused by a mild uncoupling of the respiratory chain and oxidative phosphorylation.

The respiratory chain receives electrons from NADH and succinate. This step can produce superoxides or peroxide anions, which have a deleterious effect on the cell. C60 weakens superoxide evolution by lowering the membrane potential (proton gradient between mitochondria inside and outside).

Fullerenes are radical scavengers and, therefore, very similar to the way antioxidants (vitamin C, vitamin E, beta carotene, etc.) work. However, the C60 fullerene acts in a different way.

Mechanism Of Action

The natural fullerene acts like a catalyst. It is known that this attracts free radicals to the surface of this crystal ball. This leads to a molecular rearrangement and results in a neutral compound. The fullerene itself does not bond with the free radical. It remains completely intact and does not change its structure. It continues to act due to the long coherence time of the photons.

The length of telomeres is directly related to lifespan. Telomeres wrap around the ends of chromosomes and keep them stable. According to scientific evidence, oxidative stress is a major cause of telomere shortening, the main cause of aging. C60 reduces oxidative free radicals. A reduction in oxidative free radicals may be responsible for significant increases in lifespan and vitality. This has been observed in scientific studies.

Shungite

Figure 1, Shungite rock from Karelia

Fullerenes occur in nature in minute concentrations and can be detected using mass spectrometry in graphite-like shungite, glassy fulgurite, candle soot, and craters from meteorite impacts. The C60 fullerene contained in shungite is the best studied among the fullerenes. This fact is due to its very stable shape, consisting of 12 pentagons and 20 hexagons forming a truncated icosahedron. This shape belongs to the Archimedean solids and is characterized by high symmetry and resulting stability. (25, 26, 27, 28, 29)

Since carbon compounds form the basis of terrestrial life, they enjoy considerable attention in chemistry. Meanwhile, fullerenes have also been detected in planetary nebulae, making them currently the largest known molecular form in extraterrestrial space.

Effects attributed to the shungite meteor rock (30, 31, 32, 33, 34, 35):
It has an antibacterial effect and can sterilize and purify rainwater and ponds. At the same time, it enriches soil and water with the minerals it contains.

It is permeable to electricity but not magnetic. It is said to be able to absorb negative radiation, such as electrosmog in the environment. It is said to have a pain-relieving effect when placed on the body in the affected area. The C60 fullerene acts as an inhibitor of allergic reactions and could prevent certain inflammatory diseases such as asthma, arthritis, or multiple sclerosis by inhibiting the rise of IgE and the release of histamine in the body.

What Makes C60 fullerene an exceptional antioxidant?

Conventional antioxidants, like those we find in fruits and vegetables, trap free radicals and bind them tightly. As a result, the antioxidant gets used up, and we have to keep adding it. Fullerenes, on the other hand, act like a catalyst, causing two or more radicals to react with themselves and form a stable bond. In this way, the free radicals are rendered harmless, but the fullerenes are not destroyed. Therefore, fullerenes can be applied at a 1000-fold lower dosage. (24)

Since C60 fullerenes have a slightly positive charge, they attract and neutralize the negatively charged oxidative free radicals. The fullerene itself does not bond with the free radical; it remains completely

intact without changing its structure. The reduction in oxidative free radicals may be responsible for the remarkable increase in lifespan and vitality.

Astaxanthin: The red miracles from nature

Figure 2, Flamingos with red feathers due to eating krill and shrimp

Astaxanthin is a powerful antioxidant found in some types of algae and in certain seafood such as salmon, shrimp, and crab. It has received considerable attention in the scientific and healthcare communities in recent years, largely because of its antioxidant and anti-inflammatory properties. Here are some of the potential health benefits that have been reported in experiential medicine and scientific research:

Antioxidant activity: It is known for its powerful antioxidant effects, which may help protect the body from the harmful effects of free radicals. (36, 37)

Heart Health: Some studies suggest that astaxanthin may reduce the risk of heart disease by lowering cholesterol and keeping arteries healthy. It may also help lower blood pressure and improve circulation. (40)

Skin health: Astaxanthin may help improve skin health by slowing the aging process and protecting the skin from damage caused by UV radiation. Some research has shown that it can help reduce wrinkles, improve skin hydration, and increase skin elasticity. (43)

Eye health: Astaxanthin could help promote eye health by reducing the risk of eye diseases such as age-related macular degeneration and cataracts. It could also help alleviate eye fatigue, especially in people who spend long periods of time in front of a computer screen. (39, 49)

The active ingredient, astaxanthin, is a powerful natural pigment, a natural substance from the xanthophyll class of carotenoids. Carotenoids provide the colors red, yellow, and orange in fruits and vegetables, and astaxanthin, in particular, gives salmon its typical pink color. It has been classified as a food colorant by the European Commission. However, astaxanthin can do much more than color pink - it is considered the most powerful antioxidant in the world. This means that it can prevent cell damage, such as that caused by reactive oxygen particles or UV light. This also mitigates premature

cellular aging due to "oxidative stress." Some studies indicate that astaxanthin may reduce severe cell damage, which can sometimes lead to cancer.

Astaxanthin concentrations are particularly high in plankton and algae, such as spirulina. Astaxanthin has also been detected in some fungi and bacteria. Animals that ingest astaxanthin in high doses develop a pink coloration, e.g., salmon, shrimps, lobsters, or flamingos. Salmon has the highest astaxanthin concentration worldwide. However, depending on the type of salmon, up to 1.5 kg of it would have to be consumed daily to achieve the positive effect of astaxanthin. We, therefore, recommend appropriate dietary supplements.

Good to know: When taking astaxanthin, a little vegetable oil should be added, as it is fat-soluble and the absorption is thus facilitated.

Effects of astaxanthin(36)

Grammar corrections:

The following list summarizes various effects of astaxanthin. For the most part, scientific studies provide evidence of a positive effect. However, some studies are based on tests with animal subjects, so it is not yet conclusively clear to what extent the study results can be transferred to humans.

Performance enhancement and longevity: In mice, the 'Longevity Gene' FOX03 was switched on by Astaxanthin. (38)

Diabetes: The increased blood glucose level in type 2 diabetics puts the insulin-secreting cells of the pancreas under additional oxidative stress. This damages the cells and, as scientists suspect, is also the reason for kidney dysfunction in the further course of diabetes. In a study of astaxanthin in mice, the active ingredient was able to reduce the progression of these damaging processes. After 12 weeks of treatment with astaxanthin, the animals suffering from type 2 diabetes had lower blood glucose levels than the control group of healthy mice. The animal studies also showed success in the area of secondary damage caused by diabetes, with the development of progressive kidney disease (diabetic nephropathy) being significantly slowed. (46)

Immune system and cognitive processes: Astaxanthin is said to have an anti-inflammatory effect. Studies in the elderly show that astaxanthin may prevent nerve cells and nerve fibers from dying. Thus, various aspects of memory performance may be improved. (41)

Several studies in animals have shown that the compound prevents the release of some inflammatory messengers. The astaxanthin effect was similar to that of cortisone and anti-allergic agents but weaker. Asthmatics, for example, could benefit from this effect.

Effect as sunscreen: Astaxanthin protects the skin and eyes from the inside against harmful UV radiation. Blue light and UV rays, in particular, are harmful to eye health because they increase the formation of reactive oxygen species within the retina. The consequences can be damage to DNA and inflammatory reactions that can trigger cell death. This cell death could be counteracted in scientific studies with the help of astaxanthin, provided UV rays were involved. The formation of free radicals and defects in the retina could also be positively influenced by astaxanthin. (41)

Hypertension and cardiovascular system: Astaxanthin shows several effects on the cardiovascular system: The gradual adverse remodeling of the heart, which leads to further functional impairment of the heart in various cardiovascular diseases such as hypertension, could be slowed down by astaxanthin. Furthermore, due to the intake of astaxanthin, fewer vascular deposits are formed, and already existing deposits are stabilized. This prevents the formation of blood clots that could detach and clog subsequent smaller vessels, causing heart attacks and strokes. (42)

Astaxanthin in cosmetics: With age, the skin loses tone and elasticity, wrinkles form, the skin loses moisture, and is prone to blemishes. In a double-blind placebo-controlled clinical study, the skin of volunteers optimized when they took 6 mg of astaxanthin per day, locally as well as orally, in all layers of the skin. After 4 weeks, a reduction in wrinkles and improved skin elasticity, as well as optimized moisture content, were observed. (43)

Astaxanthin and cancer: There have been over 200 studies conducted to date on antioxidant-rich diets in cancer. However, these studies mainly dealt with beta-carotene. However, since astaxanthin may be more potent than beta-carotene, it stands to reason that astaxanthin could also have a similar effect. Several possible properties have great potential for cancer prevention: the reported antioxidant effects, the anti-inflammatory properties, and the reported immune-boosting effects. So far, however, study results have been limited to animal subjects. (45, 47, 48)

Dosage: In animal studies, no side effects were observed at doses of 5 to 18 mg/kg/day. The usual manufacturer-recommended dose for humans is 4 to 12 mg of astaxanthin per day.

Astaxanthin, side effects, and interactions: Astaxanthin is considered safe to take. It has been sold as a dietary supplement on the European, American, and Japanese markets for over ten years. In a human clinical study, it was shown that taking an algae extract containing 6 mg of astaxanthin for eight weeks was tolerated without any problems.

The only known side effect when the recommended daily dose is greatly exceeded is a slight orange coloration of the soles of the hands and feet, as it is said to be deposited in skin cells. People with allergies to crustaceans should clarify in advance where the astaxanthin in the preparation to be taken comes from. If it is obtained from crustaceans, traces of it may be present in the preparation and lead to allergic reactions.

Reduced Glutathione

Glutathione (GSH), also known as γ-L-glutamyl-L-cysteinylglycine, is a tripeptide formed from the three amino acids glutamic acid, cysteine, and glycine. It is present in high concentrations in almost all cells and is one of the most important substances in the body, acting as an antioxidant. At the same time, it is a reserve for cysteine. Glutathione is not a true tripeptide because the amide bond between glutamic acid and cysteine is formed via the γ-carboxy group of glutamic acid and not via the α-carboxy group, as in a true peptide bond.

Under ATP consumption, γ-glutamylcysteine is formed from glutamic acid and cysteine. In this process, an ω-peptide bond is formed between the γ-carboxy group of the glutamic acid residue and the amino group of the cysteine residue. The enzyme involved in this process is called glutamate cysteine ligase (GCL), also known as γ-glutamylcysteine synthetase. With the help of glutathione synthase, glycine is added to the terminal carbon atom with ATP consumption.

Vitamin C and vitamin D3 are not the most powerful antioxidants. There's actually another molecule abundant in every cell that is more powerful than vitamin C or D. On top of being a potent antioxidant, glutathione is a powerful liver detox agent. All cells of the human body have the ability to synthesize GSH. In this context, the biosynthesis of the substance in the liver is essential.

ROS (reactive oxygen species), which can be formed in the course of cellular respiration, among other things, pose a significant threat to numerous cellular components. Reduced glutathione (GSH) has a free thiol group and can thus transfer electrons to ROS and render them harmless. Two oxidized glutathione molecules combine to form a disulfide bridge and a glutathione disulfide (GSSG). The enzyme glutathione reductase can produce two reduced GSH from one GSSG dimer by consuming NADPH. The redox potential of GSH is -240 mV[7], and it is 90% reduced due to the activity of glutathione reductase. A precursor of GSH is NAC (N-acetyl-cysteine).

GSH can help protect cellular macromolecules, such as proteins and membrane lipids, from "free radicals" (reactive oxygen species, ROS). In this process, glutathione is oxidized and changes from its monomeric form GSH to a dimer GSSG. ROS, which can be formed in the course of cellular respiration, among other things, pose a significant threat to numerous cellular components. Reduced glutathione (GSH) has a free thiol group and can thus transfer electrons to ROS and render them harmless. Two oxidized glutathione molecules combine to form a disulfide bridge and a glutathione disulfide (GSSG). The enzyme glutathione reductase can produce two reduced GSH from one GSSG dimer by consuming NADPH. The redox potential of GSH is -240 mV and is 90% reduced due to the activity of glutathione reductase.

Biotransformation

GSH plays an important role in phase II biotransformation of harmful substances. Substances conjugated with GSH are usually more water-soluble and can be excreted by the kidney. In this process, glutathione S-transferase, which is usually localized in the cytosol, catalyzes the reaction of GSH with electrophilic carbon. In this process, halogen, sulfate, sulfonate, phosphate, and nitro groups can be substituted by glutathione. Furthermore, GSH can be added to activated double bonds and open reactive epoxide rings. The toxifying effect includes the activation of vicinal dihaloalkanes to form a highly reactive episulfonium ring and a β-lyase mediated conversion of GSH conjugates in the kidney to reactive compounds.

Stress, poor diets, heavy metals, medications, and certain viruses and bacteria can all decrease glutathione levels. But there is a trick to supplementing with glutathione: it must be in a bioavailable form. The bioavailability of dietary glutathione is generally considered to be very low, but was investigated in April 2013 by a Penn State College study of 54 undergraduates with positive results. (50) Parenteral delivery increases GSH levels in cells. [13] Potential health benefits of glutathione, for example, as an anti-cancer agent [14] or as an agent in age inhibition [15], remain to be further investigated in clinical trials.

Conclusion

It can be recommended to every person who wants to age more healthily to carry out an anti-oxidant treatment on themselves. The three substances reported here make it possible to achieve this goal. Their positive effects are proven.

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