

Education News



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AN ALPHABET OF ANTIOXIDANTS

FROM ALPHA-CAROTENE TO ZEAXANTHIN AND ZINC

Antioxidants are a vibrant group of substances that include nutrients such as vitamins C and E, selenium, alpha and beta carotene (provitamin A), quercetin, lutein and lycopene as well as some enzymes. Antioxidant nutrients can be found largely in colourful fruits and vegetables as well as other food sources. An antioxidant is essentially anything that can help protect us from oxidative stress, which is the damage caused to our cells and DNA by highly reactive, electrically charged particles known as free radicals.



WHAT ARE FREE RADICALS?

Free radicals have been given a very bad press over the years, but it is important to note that such substances only cause damage in certain situations; in others they are crucial to our survival. Highly reactive substances in our body are what keep us alive: our health depends upon the continual dynamic reactions that take place between electrically charged substances within us. It is only when they are reacting with the wrong things that they can cause harm, and it is only then that they are termed free radicals. I sometimes liken them to children with a lot of energy: give them someone to play with or something creative to do and the results can be magical; leave them bored in a room full of china and things may well get broken.

Free radicals might therefore be described as charged substances that do not have anything appropriate to react with, and so react instead with the cellular proteins, lipids and DNA around them, causing what we call oxidative stress. This oxidative stress is damage that may prevent those cells from functioning normally, and so the body uses antioxidants as a buffer, giving free radicals something to react or "play" with to prevent them from causing harm.

AGEING AND ILLNESS

Oxidative stress has been linked to many signs of ageing, such as wrinkles, fatigue and age-related macular degeneration, where a part of the eye is damaged. Oxidative stress has also been linked to diseases such as cancer, MS, heart disease and neurological disorders such as Alzheimer's and Parkinson's disease. The affected cells seem to have been exposed to free radicals, and the body seems

to be unable to fully protect itself from them. The reasons for this may vary. Perhaps our bodies are deficient in antioxidants: selenium, for example, is known to be deficient in the soil, especially in Scotland, and so is less available in our food sources. If we are also poorly digesting and absorbing nutrients, this will also affect our antioxidant intake.

Or perhaps there is a fundamental issue which is preventing substances from reacting appropriately in the body, and so more of them start behaving as free radicals. Most chemical reactions require certain environmental conditions, so a change in pH or temperature, for example, may have a substantial effect on what kind of reactions are taking place within us.



Many antioxidants are enzymes, and enzyme production also relies on conditions such as pH and temperature being correct, as well as the necessary ingredients and cofactors for those enzymes, such as zinc and manganese.

Or perhaps the reason is that we are exposed to an increased number of sources of free radicals these days from pollution, for example, X-rays and cigarette smoke.

More likely it's a combination of the above. In any case, it would seem sensible to look more deeply at why the body is struggling and what extra support it may need, whilst perhaps increasing the amount of antioxidants available to it by an amount likely to help it manage the current situation.

ORAC SCALE

Free radical theory was first proposed in the 1950s, and a steady stream of research has followed, exploring the antioxidant potential of everything from artichokes to watermelons. Antioxidant potential is usually measured on something called an ORAC scale – Oxygen Radical Absorbance Capacity. Ground cloves rank highly on the ORAC scale with a score of 290,283, while a cup of black tea with milk scores only 264. It's important to remember that antioxidant potential isn't the be all and end all of a food's health giving properties, however. For example, chocolate is often cited for its high antioxidant potential, and it does indeed have a high ORAC score, but it also contains stimulants that may not be so beneficial, and the resultant adrenal stress may outweigh any benefit. As holistic practitioners, we are also trained to look at the whole picture, not just an isolated element, and to bring things into balance rather than take things to the opposite extreme.



THE GREAT ANTIOXIDANT DEBATE

Some research questions free radical theory, however, and one 2007 review by the American Medical Association even suggests an increase in mortality rates when antioxidant supplements are taken. Professor Frei of the Linus Pauling Institute condemns this report as inaccurate and biased, however, calling it a "flawed analysis of flawed data" that omits some important and large studies from its review. "Instead of causing harm," argues Frei, "the totality of evidence indicates that antioxidants from foods or supplements have many health benefits, including reduced risk for cardiovascular disease, some types of cancer, eye disease and neurodegenerative disease. In addition they are a key to an enhanced immune system and resistance to infection."¹

In fact, the only clear evidence we have for antioxidants doing more harm than good is in the case of beta carotene and smokers. It seems that high doses of beta carotene can significantly increase the incidence of lung cancer in smokers. Subsequent studies have shown, however, that moderate doses of beta carotene in combination with other antioxidants can actually decrease the risk of lung cancer in smokers by 16%.² As with any food or supplement, it is not necessarily the case that more is better: a measured approach is often most likely to restore balance to a situation, as well as an understanding that supplements do not usually work best in isolation.



THE COMMUNITY OF ANTIOXIDANTS

In fact, what has become increasingly clear for smokers and non-smokers alike is that antioxidants and other nutrients are found grouped together in nature for a good reason. They seem to work well together, helping each other to do their various jobs.

Vitamin C and vitamin E, for example, have been found to have greater antioxidant potential when used together, vitamin C being able to recycle vitamin E so that we can make greater use of it. One study found, for example, that vitamin C and E taken together can offer good protection against sunburn and so may help prevent premature wrinkle formation and other signs of skin damage.³ Similarly, vitamin C has been found to perform better in harmony with a range of bioflavonoids. That is why many food supplement manufacturers now provide vitamin C in a formula with citrus bioflavonoids.

SO WHY CAN'T WE GET OUR ANTIOXIDANTS FROM FOODS?

In an ideal situation, we would - as long as we were eating a good variety of really fresh food with plenty of colourful vegetables. An apple a day may really help keep the doctor away if it is part of a balanced diet and freshly picked. The longer an apple is stored, however, the lower its antioxidant potential⁴ - and it is astounding how old many of our apples are when we buy them. Often they will have been picked many months earlier.

Nutrient range in foods is often dependent on growing and harvesting conditions too. Many antioxidants and other protective nutrients are developed at certain times of year in particular soil and weather conditions. Where fruit and vegetables are forced, or grown in artificial environments, this may affect the quantity of nutrients, including antioxidants, that they contain.

In addition, the increased pollution of car engines and cigarette smoke, for example, has opened us up to a much greater level of oxidative stress that we need an increased level of protection from. So there is an argument for increasing our antioxidant intake accordingly.

WHAT TO LOOK FOR IN AN ANTIOXIDANT FORMULA

A good antioxidant formula should contain a variety of antioxidant nutrients that work well together. An effective supplement may contain a combination of the following:

- vitamin C and vitamin E
- bioflavonoids from citrus, grapeseed extract, green tea and curcumin
- quercetin, another flavonoid
- beta-carotene, alpha-carotene and other carotenoids such as lycopene, lutein and zeaxanthin
- selenium
- zinc and manganese can be useful additions, not only because of their own antioxidant properties, but also because of their role in producing the powerful antioxidant SOD (superoxide transmutase) enzymes.
- L-cysteine would also earn a place as a precursor to glutathione, a detoxifying antioxidant.
- Glutathione regenerates vitamin C, and in turn, vitamin C, together with bioflavonoids such as quercetin, help to maintain tissue levels of glutathione.

"Moderate doses of beta carotene in combination with other antioxidants may decrease the risk of lung cancer in smokers by 16%..."

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LET'S HAVE A CLOSER LOOK...

VITAMIN C

Vitamin C is perhaps the best known antioxidant, and works best when taken together with a range of bioflavonoids. It is usually in the more powerful form of ascorbic acid, but those with a more delicate digestive system may prefer vitamin C in ascorbate form, bound to minerals such as magnesium, calcium and potassium.

Vitamin C is essential in our diet to protect and renew our skin, gums and tissue throughout our body, including bones, teeth and blood cells. It also helps us to absorb iron, and so should be taken alongside any iron supplementation.

Vitamin C is most widely known for its support to our immune system, and is also a good adrenal support, making it a useful nutrient in times of stress. Its role in adrenal

support also complements its antihistamine effect⁵ in making vitamin C worth considering in the hayfever season and where there are other allergies.

Many of us take some form of vitamin C supplement, either on a daily basis or when we are feeling more vulnerable, perhaps on the onset of a cold. A quick look at the more commonly available vitamin C supplements available on the high street will reveal some unnecessary and often detrimental ingredients, ranging from calcium carbonate (chalk) to sugar or even aspartame. It is always a good idea to check the label, not just to make sure your vitamin C is delivered together with a range of suitable antioxidants, but also to make sure you are not getting more than you bargained for.

We can also get vitamin C from fresh fruit and vegetables, such as broccoli and kale –

but as it is continually working hard as an antioxidant, its levels decrease with time. You can see how rapidly antioxidants can be used up if you cut an apple or an avocado in half and watch it turn brown.

The easiest way to protect your apples and avocados from oxidising so quickly is to drizzle them with vitamin C-rich lemon juice before popping them in the fridge for later use.

VITAMIN E

Vitamin E has long been linked to heart and blood vessel protection, but its antioxidant properties also extend to helping to protect the nervous system and even sperm. Vitamin E is also known to help reduce collagen degradation, and to protect the oily structures in our skin. We have seen how it may be best used in conjunction with vitamin C, which helps to recycle vitamin E so it can be reused to help prevent oxidative damage. It also works very synergistically with selenium, another important antioxidant, as well as with a range of carotenoids.

One study monitored the detrimental effects of UV exposure on the skin of healthy volunteers taking a vitamin E and carotenoid supplement over 12 weeks, and their reaction to the UV light significantly decreased.⁶

Vitamin E is found in avocados, whole grains, nuts and seeds, together with a spectrum of carotenoids, flavonoids and other antioxidants, and so it makes sense to take it as part of an antioxidant formula rather than on its own.



BIOFLAVONOIDS

Bioflavonoids are a large group of compounds that all act not only as antioxidants but also as the vibrant yellow, orange and red pigments in most fruits, vegetables, grains, flowers, pulses and spices.

Citrus bioflavonoids are most commonly used to support the activity of vitamin C, as citrus fruits are also often rich in this vitamin, and so it makes sense that they would work well together.

Quercetin is a common flavonoid and also a building block for other flavonoids. It can be found in red grapes and berries as well as onions, broccoli, tea, apples and tomatoes. Studies on quercetin are limited, but it is thought to have anti-inflammatory as well as antioxidant properties.⁷

Curcuminoids are the yellow pigments found in turmeric, a fragrant Asian spice known to have one of the highest measurements on the ORAC scale. In Ayurvedic medicine, turmeric is an important cleansing and detoxifying agent. Turmeric is also classically used as an anti-inflammatory, particularly for the digestive system. A study of 207 IBS patients given either 1 or 2 tablets of turmeric powder daily reported a significant reduction in their symptoms, including pain/discomfort and bowel pattern.⁸ In addition, a wealth of studies has demonstrated turmeric's ability to inhibit the growth of bacteria, yeast and viruses.

Green tea extract contains catechins, which are part of the polyphenol group of flavonoids. An interesting Japanese study followed elderly residents of nursing homes as they gargled with a catechin solution 3 times a day for 3 months. The incidence of flu in the catechin-gargling group (1 person out of 83) was significantly lower than in the control group (5 people out of 48).⁹

Even more impressively, a 2006 study showed a massive reduction in tumour incidence in men with prostate cancer taking a high grade green tea extract supplement. Previous studies had shown that 30% of men with high-grade prostate intraepithelial neoplasia (HG-PIN) develop prostate cancer within 1 year after repeated biopsy, so the 2006 study was set up to see if green tea extract could prevent this.

After 1 year of supplementation, only 3% of the HG-PIN diagnosed men produced tumours, as opposed to 30% in the control group and in the prior studies.¹⁰

Catechins are highly unstable, and so their bioavailability is usually quite low. Recent research has demonstrated, however, that citrus juice can recover



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catechin levels by more than 5 times, and vitamin C on its own in ascorbic acid form can recover catechin levels by up to 13 times.¹¹

Grapeseed extract contains high levels of flavonoids called oligomeric proanthocyanidins (OPCs), which effectively protect collagen structures – in our skin and the connective tissue throughout our bodies – in several ways. They reinforce the collagen matrix of connective tissue, protect against free radical damage, and inhibit collagen damage caused by inflammation and infection.

Their antioxidant effect is reported to be up to 50 times greater than that of vitamin C and E.

A major advantage of these molecules is that they are taken up into the cell membranes and protect against both water- and fat soluble free-radicals.

CAROTENOIDS

Carotenoids are similar to flavonoids in that they are yellow, orange and red pigments that have additional important functions. While most flavonoids are water soluble, however, carotenoids are fat soluble, which affects how they are absorbed into the body and also which part of the cell they are able to protect.

Carotenoids include a group of antioxidant nutrients called carotenes, such as the beta-carotene and alpha-carotene found in carrots, sweet potatoes and spinach, and the lycopene rich in tomatoes, watermelons and guavas. Carotenoids also include a group of oxygenated carotenes called xanthophylls, such as zeaxanthin and lutein, found in broccoli, kale and pea, and cryptoxanthin, found in red peppers, avocados and papaya.

Carotenoids in plants and algae absorb blue light, and have several roles in photosynthesis, the way in which plants harness energy from light.¹² This may be how xanthophylls such as lutein and zeaxanthin seem to protect our eyes from macular degeneration: by absorbing harmful UV rays that may otherwise damage this yellow tinted part of the retina at the back of the eye.¹³

Carotenoids are also noted for their antioxidant capacity, and are thought to be able to improve cell communication, both of which have made them prime candidates for trials as a cancer preventative.¹⁴

The corpus luteum, which plays an important role in progesterone release during pregnancy (until the placenta is formed enough to take over), is yellow in colour due to its incredibly high carotenoid content, and so it is thought that carotenoids play an important role in reproduction too. Finally, four carotenoids are precursors to vitamin A, namely beta-carotene, alpha-carotene, gamma-carotene and beta-cryptoxanthin. Vitamin A, otherwise known as retinol, helps us to adjust to a drop in light conditions, which means that carrots really can help you see in the dark. Vitamin A also has several other functions in the body, including a role in gene transcription and maintaining healthy skin and bones.



SELENIUM

Selenium is a mineral found in great quantities in brazil nuts, and also to a lesser extent in meat and fish. Once in the body, selenium is converted to selenoproteins: some of these help to produce thyroid hormones, and so influence our whole metabolism, from energy levels to heartbeat.

Others can be used as antioxidants for protection, and selenium has been studied with great interest in terms of cancer and heart disease prevention.

One study of over 3000 men showed that those with the lowest levels of selenium had a 70% higher risk for heart disease.¹⁵



Selenium is also important to help protect against toxic heavy metals and hydrogen peroxide, as well as modulating the activity of prostaglandins and platelets, which, together with its antioxidant potential and role in supporting the thyroid, has earned selenium a reputation for helping to maintain a healthy immune system.¹⁶

It will be no surprise then that low selenium levels have been correlated with a variety of cancers, arthritis, HIV and AIDS.

ZINC AND MANGANESE

Zinc is well known as an anti-inflammatory, and so plays an important role in the health and integrity of all our tissues and membranes, including the digestive tract, the sinuses, the brain and the skin. Zinc seems to have a particular affinity with the skin, and studies have backed up its usefulness in aspects such as collagen production and wound healing. One in particular focuses on zinc's role as an antioxidant, possibly because it replaces free radical activating minerals, such as iron and copper, at critical sites in cell membranes and proteins. Alternatively, zinc ions may induce the synthesis of metallothionein, a protein that protect against free radicals.¹⁷

“Zinc plays an important role in the health and integrity of all our tissues and membranes”

In addition, zinc and manganese are crucial ingredients in hundreds of enzymes, including those involved in detoxification, in particular superoxide transmutase (SOD). Manganese-bound SOD works to prevent oxidative damage in the cell's mitochondria,

the powerhouse of the cell, and has been researched in terms of cancer prevention. Other forms of SOD are bound to zinc and copper, including extracellular SOD (SODEX), which acts as an antioxidant outside of the cell. The male testes contain higher concentrations of SODEX than anywhere else in the body, and it is believed that this zinc containing enzyme helps to protect sperm from oxidative damage.

Other manganese enzymes are responsible for the nourishing the brain and nerves, helping to regulate blood sugar, breaking down and metabolising some of our foods, wound healing and much more.

L-CYSTEINE

L-Cysteine is a sulphur amino acid with antioxidant properties, and may also play a part in detoxification within the body, particularly with heavy metals. It is also a precursor to another antioxidant called glutathione. Glutathione is found in every cell in our body, and is one of our most important detoxifiers.

A 1995 review of glutathione research found links and benefits for a wide range of illnesses, from liver and kidney disease to heart and lung conditions; from pre-eclampsia to Parkinson's; from sepsis to cataracts.¹⁸ Further studies have demonstrated that glutathione may offer protection against various types of cancer,¹⁹ and also an improvement in sperm motility and morphology.²⁰

Glutathione regenerates vitamin C, our most well-known antioxidant. In turn, vitamin C, together with bioflavonoids such as quercetin, help to maintain tissue levels of glutathione.

AN ALPHABET OF ANTIOXIDANTS

What seems most clear is that each of these vibrantly colourful antioxidants works best when surrounded and supported by its family: the other antioxidants that appear with it in nature. And so where we feel we need to increase our antioxidant support above and beyond what we can achieve with diet alone, it makes sense to take a formula that provides an A-Z of antioxidants, from Alpha-carotene, Beta-carotene and vitamin C right through to Zeaxanthin and Zinc. The synergy of such a spectrum would aim to provide a vibrant protective shield for each and every cell in our body, so they can all get on with the many jobs they perform each moment to keep us healthy and well.



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Kirsten Chick is a qualified and practising Natural Nutritionist and member of the Federation of Nutritional Therapists. To find out more please visit www.connectwithnutrition.co.uk.

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