

ESU 009– Role of antioxidants as nutraceuticals & functional foods

Lecture 16



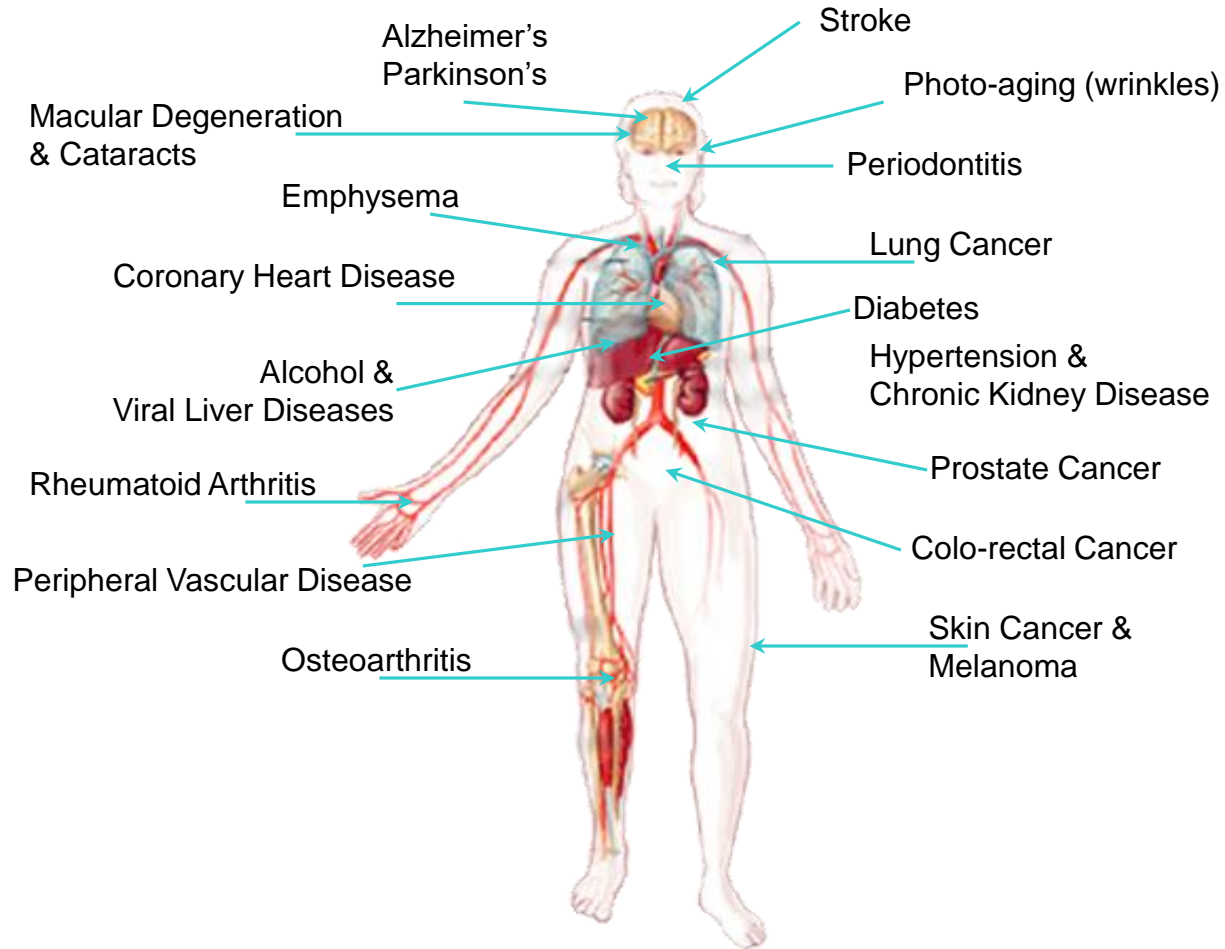
Antioxidant What does it do?

- Provides key nutrients needed by the body to neutralize free radicals.
- Helps protect against cellular damage. May exhibit anti-aging benefits.
- Super ORAC (Primary) Antioxidants are the body's own natural defense against free radicals.
- They scavenge or 'mop' them up before they have a chance to harm cells.

Antioxidants

- Slow or prevent damage to body cells
- May improve immune function and lower risk for infection and cancer
- Carotenoids – beta carotene (familiar)
- Vitamin C
- Vitamin E
- Found in colorful fruits/veggies and grains

Free Radical Diseases



The free radical diseases

- Cancer initiation and promotion is associated with chromosomal defects and oncogene activation. It is possible that endogenous free radical reactions, like those initiated by ionizing radiation, may result in tumour formation.

The free radical diseases

- **Atherosclerosis** may be due to free radical reactions involving diet-derived lipids in the arterial wall and serum to yield peroxides and other substances. These compounds induce endothelial cell injury and produce changes in the arterial walls .

Antioxidants

- vitamin E
- vitamin C
- carotenoids

vitamin E

- Vitamin E is a fat-soluble substance present in all cellular membranes and is mainly stored in adipose tissue, the liver and muscle. Vitamin E is a principal antioxidant in the body and protects polyunsaturated fatty acids in cell membranes from peroxidation.

Vitamin E and cancer

- Besides being a free radical scavenger, vitamin E at high intakes enhances the body's immune responses. Vitamin E also inhibits the conversion of nitrites in the stomach to nitrosamines, which are cancer promoters.

Vitamin E and cardiovascular disease

- Vitamin E intakes are associated with lowered risk of angina and mortality from heart disease.

Vitamin E and neurological disorders

- Supplementation with vitamin C and E might be of benefit in slowing the progression of Parkinson's disease.**

Vitamin C

- Vitamin C, or ascorbic acid, is a water-soluble vitamin. This vitamin is a free radical scavenger, it is considered to be one of the most important antioxidants in extra cellular fluids. Its protective effects extend to cancer, coronary artery disease, arthritis and aging.

Vitamin C and cancer

- Vitamin C is effective in protecting tissues against oxidative damage. It suppresses the formation of carcinogens. Numerous studies have reported the protective effect of fruit and vegetable consumption on incidence of cancer . This is mainly attributed to the protective effect of vitamin C against cancer.

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Vitamin C and cardiovascular disease

- Vitamin C may lower total cholesterol in the blood, thus reducing the risk of cardiovascular disease. Coronary heart disease mortality is higher in those with blood vitamin C levels that are near or in the deficient range.

Vitamin C and cataracts

- High intake of fruits and vegetables which are rich sources of ascorbic acid appear to be protective too. In several studies, cataract patients were shown to have low vitamin C and E intakes and low plasma vitamin C levels.

Carotenoids

- Carotenoids are a group of red, orange and yellow pigments found in plant foods, particularly fruits and vegetables.
- Some carotenoids like b-carotene act as a precursor of vitamin A; others do not.

Superoxide Dismutase (SOD) is essential for the body and is:

A metalloprotein – containing several sub units organised around a metallic group

And most importantly

An enzyme – the antioxidant enzyme SOD eliminates, *in a continuous way*, superoxide radicals, precursors of other oxygen reactive forms (secondary free radicals)

Why is SOD necessary?

SOD acts at the source. It is the first and one of the major components of the body's antioxidant system.

SOD is a powerful and efficient antioxidant:

- **1 iu SOD eliminates 1 μ mol superoxide/min and SOD has an *active lifespan of several days!***
- **In the end, billions of superoxide molecules destroyed**

SOD is a primary antioxidant and possibly our most important one

Reactive oxygen species: formation of secondary free radicals

Hydroxyl radical induces the formation of secondary free radicals:

- **Secondary free radicals or organic peroxides are very toxic**
- **They increase oxidative reactions which are propagated from one to the next**
- **They are directly responsible for cell alterations and destruction**
- **They indirectly participate in the inflammation process**

Antioxidant systems: the primary antioxidants

The primary antioxidants:

- are *endogenous molecules*
- act at the source (where free radicals are created)
- are enzymes which *continuously eliminate* the free radicals just formed:
 - SOD eliminates the superoxide ion
 - catalase and the glutathione peroxidase eliminate hydrogen peroxide

Antioxidant systems: the secondary antioxidants

The secondary antioxidants

- are *exogenous molecules*, carried by food (vitamins A, C, E, polyphenols...)
- they scavenge the secondary free radicals
- one molecule of a secondary antioxidant traps one free radical molecule – a 1:1 relationship

Oxidants and antioxidants in the body

Under *normal circumstances* and conditions, the body's endogenous antioxidant systems are able to neutralize the oxidant (free radical) molecules

Therefore

→ *no oxidative stress means*

→ *no cell damage*

Oxidative stress...

**...is the result of an imbalance
between oxidant and antioxidant
production**

Thank you

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