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Review Article

ANTIOXIDANTS FROM NATURAL SOURCE: RAY OF HOPE FOR OXIDATIVE DAMAGE

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ABSTRACT
Intensive oxidative processes occurring in human organism lead to formation of oxygen reactive forms, which can damage systemic cells and tissues. Antioxidants are substances that may protect cells from the damage caused by unstable molecules known as *free radicals*. These protective compounds are common in our foods such as Vitamins A, C, E and Coenzyme Q10. Also carotene such as beta-carotene, which is high in carrots, Lycopene, which gives tomatoes their colour, is a powerful antioxidant. Grape seed, maratime pine bark and green tea extracts contain catechins that have potent antioxidant properties and have become popular natural medicines. Free radical damage may lead to ageing, heart disease, hypertension, cancer, diabetes etc. The present review aims to highlight the natural sources of antioxidants and its role in disease management.
Key words: Antioxidants, Free radicals, Natural source, free-radical scavengers.

INTRODUCTION

Antioxidants are defined as molecules which can be safely interact with free radicals and terminate the chain reaction before vital molecules are damaged. Antioxidants are also known as *free radical scavengers*. In other words we can say that Antioxidants are a type of complex compounds found in our diet that act as a protective shield for our body against certain disastrous enemies (diseases) such as arterial and cardiac diseases, arthritis, cataracts and also premature ageing along with several chronic diseases[1].

Free- radicals: a cause for cell damage

Free radicals can be defined as chemical species possessing an unpaired electron, which are extremely reactive, short lived and damaging activity towards macromolecules like proteins, DNA and lipids. They are produced continuously in cells either as

- accidental byproducts of metabolism or during phagocytosis. They can be formed in three ways[2]
- by the homolytic cleavage of a covalent bond of a molecule.
- by the loss of a single electron from a normal molecule. (or)
- by the addition of a single electron to a normal molecule.

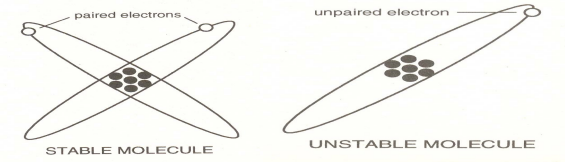

Figure: 1 Representing Stable Molecule and Unstable Molecule

In simple words, free radicals are molecules that have lost an electron and try to replace it by reacting with other molecules.

Free radicals are considered as unstable due to the existence of at least one unpaired electron. They react quickly, with other compounds, trying to capture the needed electron to gain stability. Generally free radicals attack the nearest stable molecule, "stealing" its electron. When the "attacked" molecule loses its electron, it becomes a free radical itself, beginning a chain reaction. Once the process is started, it can cascade, finally resulting in the disruption of a living cell.

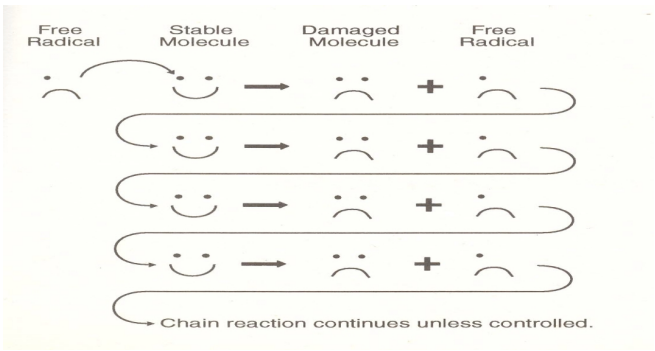

Figure: 2 Representing chain reaction of free radical damage

Due to biochemical processes occurring in the body, it is normal for free radicals to be present in the body at all times. A normal healthy immune system is normally able to control the existence of free radicals and minimize their potential damage. Not all free radicals are potentially dangerous. For example, the immune system creates valuable free radicals to control and destroy virus and bacteria. Other free radicals produce vital hormones. Indeed, we need free radicals in our everyday body function.

Sources of free radicals in the body [4]

Free radical formation occurs continuously in the cells as a consequence of both enzymatic and non-enzymatic reactions. Enzymatic reactions which serve as sources of free radicals include those involved in the respiratory chain, in phagocytosis, in prostaglandin synthesis and in the cytochrome P450 system. Free radicals also arise in non-enzymatic reactions of oxygen with organic compounds as well as those initiated by ionizing radiations. Some internally generated sources of free radicals are,

- Phagocytes
- Xanthine Oxidase
- Reactions Involving Iron And Other Transition Metals
- Arachidonate Pathways
- Peroxisomes
- Exercise
- Inflammation

- Ischaemia/Reperfusion.

Some externally generated sources of free radicals are,

- Cigarette Smoke
- Environmental Pollutants
- Radiation
- Ultraviolet Light
- Certain Drugs, Pesticides, Anaesthetics and Industrial Solvents
- Ozone.

Figure: 3 Representing Sources of Free Radicals

Effects of excess of free radicals[1]

- Free radicals damage DNA, RNA, proteins, enzymes
- Lead to the formation of tumours & cause cancers.
- Cardiovascular diseases
- Nervous disorders
- Premature ageing
- Parkinson's & Alzheimer's diseases
- Rheumatic & Pulmonary disorders

Involvement of free radicals in human diseases[5]

Free radical reactions are expected to produce progressive adverse changes that accumulate with age throughout the body. Cancer and atherosclerosis, two major causes of death, are salient "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 tumor formation. The highly significant correlation between consumption of fats and oils and death rates from leukemia and malignant neoplasia of the breast, ovaries and rectum among persons over 55 years may be a reflection of greater lipid peroxidation. Studies on atherosclerosis reveal the probability that the disease 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.

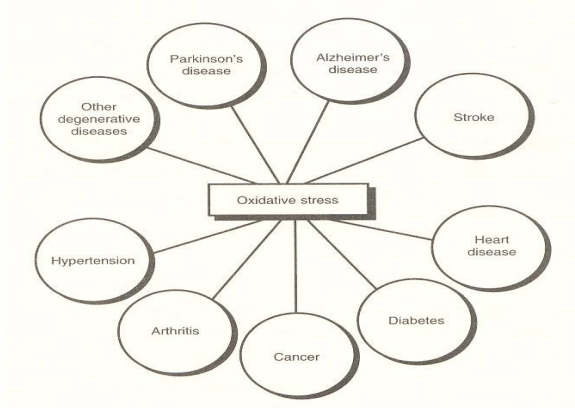

Figure: 4 Showing Diseases associated with Free Radicals (Oxidative Stress)

Mechanism of action of antioxidants

Chemically antioxidants work by one of the following mechanisms

a) by donating electron
b) by donating hydrogen
c) by scavenging oxygen and
d) by scavenging free radicals.

How do antioxidants work?

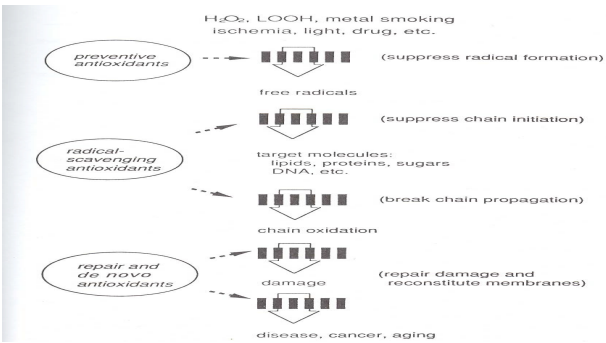

Figure: 5 Showing ways of action of Antioxidant works

Compounds as antioxidants [1, 3, 6]

- Tannins
- Phenols- Pyrogallol, Gallic Acid.
- Flavonoids- Quercetine, Rutin, Kampferol.

It scavenges free radicals and combat pathological disorders generated by phytochemicals' Reactive Oxygen Species (ROS).

- Carotenoids- α- carotene, β- carotene, Cryptoxanthin, Lycopene, Lutein & Zeaxanthin.

These are a group of antioxidant nutrients present in many fruits and vegetables and are found effective if taken with dark coloured fruits such as carrots, tomatoes, beets, etc.

- Vitamins- VitC, VitE and VitA.

Vitamin C - It prevents free radical damage due to its property of donating free radicals. It is beneficial in boosting immune system. The main sources of Vitamin-C are carrots, peaches, sweet potatoes, oranges, broccolis, etc.

Vitamin E - Both plants and animals serve as a source of vitamin E. It has been found beneficial against certain types of cancer & cardiac problems. It is known as *'scavenger of free radicals'*. Vitamin E is mainly present in nuts, whole cereal grains, almonds, vegetable oils etc

- Minerals- Selenium is an essential component of several enzymes that prevent free radical formation & their removal from blood stream. It occurs in grains, low-fat dairy products, poultry, organ meat, seafood etc.

Antioxidants from natural sources

Fruits[7]

Source	Active constituents	Mechanism	Disease management
Carrots	α- and β-carotene, Phenolic compounds	lipid per oxidation	Pancreatic, colon, breast, liver cancer
Strawberries	Vitamin C, Bioflavonoid	Antioxidant	Various types of cancer
Olives	Polyphenols	Antioxidant	Cancer
Grape	Alanine,α-tocopherol, ascorbic acid, β -carotene, β -sitosterol, histidine, OPC, methionine, Palmitic acid, selenium	-	Reduce LDL cholesterol & High Blood Pressure, Strengthens blood vessel & capillaries, Immune modulatory

Table: 1 Showing Fruits with Antioxidant Activity

Vegetables

Source	Active constituents	Mechanism	Disease management
Beetroot	anthocyanidins	inhibit oxidation of lipids in the body	Diabetes
Garlic	alliciin	scavenge free radicals in the body	Cancer

Table: 2 Showing Vegetables with Antioxidant Activity

Plants[1]

Source	Active constituents	Mechanism	Disease management
Rosemary	Carsonicacid, rosemaric acid, β –sitosterol, caryophylleneoxide, eugenol, isoeugenol	Scavenges free radical, inhibit lipid oxidation	Antioxidant
Turmeric	Curcumin	Prevents free radical damage	Premature ageing, antinflammatory
Ginkgo	EGB 761, ginkgogolide	Free radical scavenger	Prevents premature ageing
Basil	Ascorbic acid, β- carotene, β-sitosterol, eugenol, Palmitic acid, tannin	Free radical scavenger	Used against arthritis, muscular pains, rheumatism

Table: 3 Showing Plants with Antioxidant Activity

Sources of Antioxidants in Different Nations Diets

The levels and kinds of antioxidants present in diet depend mostly on the kind of products and the amount in which they are most often consumed. The studies conducted in the USA showed that the main source of antioxidants in the American diet are fruits and vegetables, where 26% of poliphenols is supplied and 25% of total antioxidants level derives from oranges. Generally, the consumption of polyphenols is at the level of about 1 g/day, from which 45% are biflavons, in 20% – catechins and in 17% – anthocyanins[8]. In the Finnish diet, a high level of anthocyanins is observed, reaching up to 200 mg/day as the result of a very big consumption of berry fruits rich in these compounds: cranberries, bilberries. In the Netherlands, significant consumption of flavonol monomers (50 mg/day) is observed, mostly from tea, chocolate, apples and pears. Notably a high consumption of catechins and proanthocyanidins supplied with apples, pears, grapes and red wine is recorded in Spain. In France, daily polyphenols intake is at the level of 1 g. About 28% of this value is supplied by fruits and vegetables (mainly apples and patatas) and the rest – from coffee, tea, wine, beverages and cereals. Drinking coffee has a very important effect on the consumption of polyphenols from the group of hydroxycinnamic acids in all countries. Consumption of a few cups daily can supply up to 1000 mg of chlorogenic acid. The diet of Asian countries is rich in isoflavonoids (20-45 mg/day), which is connected with a high consumption of soybean (10- -35 g/day[9, 10, 11]. The consumption of phenolic compounds in Poland is not well known yet. There are many products on the market which can supply them. The potential sources in our diet can be potatoes, *Brassica* vegetables, coffee, tea, apples, beverages and beer.

Functions of Antioxidants[1]

- Antioxidants such as Vitamin-C & E boost our immune system.
- Certain phytochemicals have beneficial effect on heart diseases.
- Antioxidants lower the level of Low-density lipoprotein (LDL) cholesterol, thus preventing plaque deposition in the blood vessels.
- It is beneficial in cancer prevention.
- Antioxidants neutralize substances that can damage the genetic material by oxidation.

CONCLUSION

Antioxidants have been shown to play an important role in disease prevention. This review throws light on the natural sources which do have the potential to be used as antioxidants.

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