

Dietary Antioxidant An Indispensible Nutrient

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Free radicals prevail as atoms, molecules or unpaired electrons being extremely reactive as well as unstable¹. They can lead to chemical reactions alongside different molecules. Having been originated from constituents like oxygen, sulphur as well as nitrogen which contribute towards production of reactive oxygen species (ROS), reactive nitrogen species (RNS), reactive sulphur species (RSS)¹. They include superoxide anion ($O_2^{\bullet-}$), hydroperoxyl radical (HO_2^{\bullet}), hydroxyl radical ($\bullet OH$), hydrogen peroxide (H_2O_2), singlet oxygen (1O_2), hypochlorous acid (HOCl) and peroxy nitrite ($ONOO^-$). Free radical species are formed in the course of plentiful oxidative metabolic processes in mitochondria¹.

There is extremely mild equilibrium between the making together with the counteraction of ROS through antioxidants. As a consequence whenever the equilibrium gravitates towards over production of ROS then as a sequel to oxidative stress cells begin deteriorating.

Being usual component of metabolism inside mitochondria, by way of xanthine oxidase, peroxisomes, inflammation processes, phagocytosis, arachidonate pathways, ischemia and physical exercise, free radicals production occurs inwardly³. Assisting with advanced making of free radicals are extraneous causes including smoking, environmental pollutants, drugs, pesticides, industrial solvents as well as ozone².

Free radicals exist as either atoms, molecules, ions inclusive of unpaired electrons which are extremely unstable plus in addition efficacious in relation to chemical reactions alongside other molecules³. Emanation of free radicals is from three elements including oxygen, nitrogen as well as sulfur, hence forming reactive oxygen species (ROS), reactive nitrogen species (RNS) as well as reactive sulfur species (RSS). ROS consist of free radicals such as superoxide anion ($O_2^{\bullet-}$), hydroperoxyl radical (HO_2^{\bullet}), hydroxyl radical ($\bullet OH$), nitric oxide (NO) plus other species such as hydrogen peroxide (H_2O_2), singlet oxygen (1O_2), hypochlorous acid (HOCl) and peroxy nitrite ($ONOO^-$)³. Free radicals, antioxidants as well

as co-factors prevail as three predominant spheres which presumably may be partly responsible for aging process retardment¹.

DNA is also affected with free radicals attack. Changes are both chemical and structural. They are deletions, frame shifts, strand breaks, chromosomal arrangements, amendments of all bases, formation of base-free sites⁴.

Peroxidation of lipid is begun through advancement toward side chain of fatty acid via a free radical directed towards separating a hydrogen atom from a methylene carbon⁵. Higher number of double bonds, makes it additionally simple to remove hydrogen atoms to form a radical and produce monounsaturated fatty acids and saturated fatty acids. The reaction continues with the formation of peroxy radical that dislodges further hydrogen atoms and completes the process of lipid peroxidation⁵.

There are two chief classes of antioxidants. These include enzymatic antioxidants as well as non-enzymatic antioxidants.

In addition the enzymatic antioxidants exist as grouped into primary as well as secondary enzymatic defenses⁵. Three important enzymes constitute primary defence and their function is controlling formation of free radicals. These include glutathione peroxidase, which provides two electrons reducing peroxides through formation of selenols, catalase which turns hydrogen peroxide to water plus molecular oxygen. Also superoxide dismutase, which changes superoxide anions towards hydrogen peroxide¹. As part of secondary enzymatic defense, the enzymes are glutathione reductase as well as glucose-6-phosphate dehydrogenase⁶. Glutathione reductase reduces glutathione an antioxidant against oxidized state of it, towards reduced form of it⁶. Glucose-6-phosphate reconstructs NADPH, leading to reducing environment⁶. The group of non-enzymatic antioxidants includes vitamins such as A, E, C, enzyme cofactors (Q10), minerals like zinc and selenium, peptides like glutathione, phenolic acids as well as nitrogen compounds like uric acid⁵.

The antioxidants are playing major role in human health and immune system, as they are maintaining function and structure of cell by means of destruction of free radicals⁷. Carotenoids and tocopherol in combination giving more potent antioxidant effect on biological membranes the lipid bilayers⁷. Carotenoids detoxify nitrous oxide, sulfonyl, thiyl, peroxy and single oxygen and save the lipid peroxidation from hydroxyl and superoxide free radicals⁷. Optimum nutrient content allows efficacious absorption as well as metabolism of antioxidants in food⁷. Reactive oxygen species are formed by partial reduction of molecular oxygen as a result of aerobic metabolism through

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the reaction with drugs and environmental toxins⁸. They produce dangerous chemical outcomes effecting DNA, lipids, proteins and lead to death of cell. Oxidative stress is a condition which is produced due to excess of free radicals and conversely as a result of diminished antioxidant⁸. Membrane lipid peroxidation causes membrane fragility leading to anemia which is hemolytic⁹. Effect of reactive oxygen species on lipids, proteins, carbohydrates plus DNA culminates in numerous diseases, rheumatoid arthritis, reperfusion injury, atherosclerosis and lung diseases¹⁰.

Tissue defense mechanism against free-radical damage generally includes vitamin C, vitamin E and α -carotene and other carotenoids as the major vitamin antioxidant sources⁵. In addition, several metalloenzymes which include glutathione peroxidase (Se), catalase (Fe) and superoxide dismutase (Cu, Zn, and Mn) are also critical in protecting the internal cellular constituents from oxidative damage⁵.

It is extensively established that a plant-based diet incorporating increased indulgence in consuming fruits, vegetables as well as several loaded with nutrient plant-based foods can lower the risk of diseases related to oxidative stress.¹¹ Natural antioxidant molecules have been suggested as a flipside mode of assistance for the prevention of age-related neurological diseases¹². Various types of antioxidant molecules such as polyphenols and carotenoids as well as long-established antioxidant vitamins, vitamin C and E can enrich with this prevention¹². According to epidemiological studies significant differences exist in the prevalence of various diseases among communal groups which have distinctive food practices. As an instance, epidemiological evidence has revealed that the Mediterranean diet, that has ample antioxidants, has an efficacious role in the prevention of age-related diseases like Alzheimer's. Green tea polyphenols are considered as strong antioxidants countering hydroxyl radicals, nitric oxide and lipid oxidation¹².

The dietary antioxidants like ascorbates, tocopherols as well as carotenoids are acknowledged. Furthermore, superfluous reporting exists concerning role of these in health. Vitamin C, vitamin E, along with betacarotene plus additional carotenoids as well as oxycarotenoids, including lycopene, lutein are amongst maximally extensively investigated antioxidants from diet.¹³ Vitamin C has been studied as an exceptionally significant water-soluble antioxidant within extracellular fluids¹³. It has a role in counteracting reactive oxygen species within aqueous state prior to peroxidation of lipid. An essential soluble in lipid antioxidant is vitamin E. It is extremely potent chain-breaking antioxidant being associated with cell membrane, shielding fatty acids in membrane against lipid peroxidation¹³. Tissues upscale in lipid derive antioxidant protection through beta carotene as well as additional carotenoids¹³.

Consumption of 250g of strawberries by healthy participants was correlated to reasonable yet important antioxidant

activity elevation within serum as revealed by an evaluation, exhibiting possibility of boosting defense of body as counter to long-standing disease¹⁴. Antioxidants can prevail as synthetic or natural. Various sources of natural antioxidants include legumes, nuts, oilseeds, cereals, fruits, vegetables, animal products¹⁵. Adverse free radicals, having involvement in highly frequent cancers as well as distinct degenerative diseases inclusive of inadequate brain activity are scavenged by antioxidants¹⁵.

Chief sources of naturally occurring antioxidants include fruits, vegetables, whole grains, green and black tea, coffee¹⁵. Antioxidants from oilseeds are represented by flaxseed, sunflowers, soybean, cottonseed and canola antioxidants. Fruits include various vitamins and mineral salts as well as dietary fiber¹⁵. Nearly all fruits constitute a sufficient way of providing vitamin C, carotenoids as well as polyphenolic compounds¹⁵. As proclaimed, extremely powerful antioxidant activity is linked to apples, restricting cancer cell propagation, lowering lipid oxidation, in addition decreasing cholesterol. As researched potato provides an adequate supply of antioxidants such as ascorbic acid, α -tocopherol and polyphenolic compounds¹⁵.

Vegetables as well as fruits constitute the predominant source of flavonoids¹⁵. It has been revealed that pumpkin seed extract has anticancer, antimutagenic as well as antioxidant activities¹⁵. According to sufficient research black pepper as in piper nigrum seeds exhibit antioxidant plus radical scavenging activities. The finest sources of antioxidants from amongst vegetables are tomatoes, red pepper, brassica vegetables, onion, garlic and red beet¹⁵.

Antioxidants can be treated as healthy compounds as advocated. It has been revealed by surveys that natural antioxidants exhibit exceptional role in humans, in addition they are free from harm¹⁵. Hence, we should use them in our diet. Accordingly use of these compounds as well as products assuredly influences our own health, as a consequence they must be utilized by us in our food.

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