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IP Journal of Nutrition, Metabolism and Health Science

Journal homepage: <https://www.jnmhs.com/>

## Short Communication

# Dietary antioxidants: An overview

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### ARTICLE INFO

#### Article history:

Received 15-10-2024

Accepted 19-11-2024

Available online 03-12-2024

#### Keywords:

Free radicals

Antioxidant

SOD

Pollution

Flavonoids

### ABSTRACT

The substances which inhibit oxidation are called as antioxidants. They are also known as free radical scavengers. The decrease in concentration of antioxidant is termed as oxidative stress. The presence of antioxidants decreases the risk of inflammation, liver disease, cardiovascular, cataract, nephrotoxicity and neurodegenerative diseases. They are categorized as exogenous and endogenous. Endogenous antioxidants include enzymatic and non-enzymatic. Enzymatic antioxidants are glutathione peroxidase, superoxide dismutase and catalase whereas non-enzymatic are uric acid, metanolin lipoic acid, glutathione and bilirubin. Exogenous are carotenoids, Vitamin E, A, C and flavonoids. Apart from natural antioxidants, synthetic antioxidants such as octyl gallate, butylated hydroxyanisole, propyl gallate, hydroxytoluene and tertbutylhydroquinone are used to enhance flavor, color extending shelf life of the product. This paper discusses on the various role of antioxidants.

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## 1. Introduction

Free radicals or reactive oxygen species (ROS) are unpaired electrons active to take part in chemical reactions with other molecules. The metabolic system in humans create free radicals. The routes of free radical formation include mitochondria, inflammation, peroxisomes, xanthine oxidase, phagocytosis, injury, arachidonic acid pathways, free metal ions, respiratory burst, cigarette smoke, industrial solvents, environmental pollutants and UV irradiation. The superoxide anion ( $O_2^-$ ), hydrogen peroxide ( $H_2O_2$ ), singlet oxygen, nitric oxide (NO) falls under free radicals and all these causes DNA damage. When the concentration of free radicals are higher it is harmful, subsequently, when the levels are moderate it guard against infection.<sup>1</sup>

When foods undergo chemical reaction, it brings rancid flavor making it unacceptable. It leads to product rejection, undesirable compounds, change in color, texture and loss of

nutritive value. This oxidation reaction causes mutagenesis and carcinogenesis. The application of antioxidant in food products, prevents lipid oxidation.<sup>2</sup> The use of plant extracts as natural antioxidants include grape seed, pine bark, rosemary, cinnamon, green tea, pomegranates had similar properties of synthetic antioxidants.

### 1.1. Dietary antioxidants

The dietary antioxidants are substances present in foods that decreases the effect of free radicals. The dietary antioxidants are flavonoids (flavonols, flavones, theaflavins, catechins, proanthocyanidins, flavones, isoflavones and anthocyanidins). Non-flavonoids (stilbenes, lignans, phenolic acids), vitamins (A, C and E) and minerals (selenium, magnesium, zinc, copper and iron). These compounds alleviates the oxidative stress. The antioxidants levels in the body can be achieved through adequate consumption of fruits and vegetables. Spice and herbs are natural antioxidants using for centuries to preserve foods.

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Antioxidants protect the cells by conversion of radical species to non-radical species.

### 1.2. Flavonoids

Flavonoids belong to a group of polyphenolic compounds present widely in plant-based foods. Flavonols, catechins, flavones, flavonones, isoflavone and anthocyanidins. Studies have identified more than 4000 flavonoids occurring naturally. They are present in fruits, vegetables, tea and red-wine. Body cannot manufacture flavonoids and are dependent on diet. It has anti-cancer, anti-diabetic, anti-viral, anti-allergic, anti-inflammatory properties. Flavonoids work by chelating with metal ions such as copper, iron, zinc. They act as scavengers by inhibiting the formation of peroxy radical, xanthine oxidase and nitric oxide.<sup>3</sup>

### 1.3. Vitamins

Vitamin A is needed for functioning of skin, eyes and internal organs. They are found in green leafy vegetables and in yellow and orange color based foods. They act as antioxidant by combining with peroxy radicals preventing peroxidation of lipids.<sup>4</sup>

Vitamin C is present in amla and citrus based foods. Living organisms generate nitrogen species and reactive oxygen in their physiological activities. The ROS can be balanced by natural antioxidants and disruption leads to oxidative stress.

The antioxidant system has three levels of defence:

1. Biosynthesis and activation of antioxidant enzymes
2. Free radical scavenging
3. The repair of oxidative damage Ascorbic acid works at the three levels<sup>4</sup>

It reacts directly with peroxy radicals and indirectly with vitamin E by restoring fat soluble vitamin properties. It functions as antioxidants at intracellular and extracellular levels. Vitamin E is a fat soluble, is dependent on lipid and lipoprotein metabolism for their delivery, prevents lipid peroxidation. It is found in oils, nuts and vegetable oils. It tocopherol radical oxidise other lipids, produces quinones and forms non-reactive tocopherol dimers. It makes the tighter packing of membrane and giving stability to cells.

## 2. Minerals

### 2.1. Selenium

It is a trace element gained significance due to its effect in the maintenance of health. Deficiency leads to Keshan disease. The level of selenium content in food depends on the soil selenium levels. It acts as an antioxidant enzyme in glutathione peroxidase, iodothyronine deiodinases and thioredoxin reductase. Selenium prevents cancer, heart

disease and immunity. There are proteins containing selenium called as selenoproteins and more than 25 compounds were identified. Studies found that presence of ROS cause oxidation of low density lipoprotein and initiates the atherosclerosis in heart disease.<sup>5</sup>

### 2.2. Magnesium

Magnesium is a micromineral takes part in more than 300 enzymatic reactions in the body. It is an important component of alkaline phosphatase which is needed for vitamin synthesis and inflammatory response. It is an earth metal and fourth most cation in the body and second intracellular cation next to potassium.<sup>6</sup> Studies found low levels of magnesium in the body is related to cardiovascular disease and death. Magnesium deficiency causes excessive production of ROS, glutathione is an intercellular antioxidant and Mg is a cofactor in glutathione synthesis. Low levels of mg leads to reduction in the antioxidant activity.<sup>7</sup>

### 2.3. Zinc

Zinc is needed in the body for functioning of lipid and glucose metabolism, formation of insulin, protects from stroke angina pectoris and death. Zinc inhibits the production of free radicals of superoxide anion, hydrogen peroxide, peroxy nitrite and radical hydroxyl. It functions as an antioxidant by binding to thiol groups and preventing from oxidation. It is a cofactor of superoxide dismutase which is suppressed under deficiency states.<sup>8</sup>

### 2.4. Copper

It is a trace element seen cells and tissues of liver. It exist in both oxidized and reduced state. It acts as a cofactor for a range of enzymes such as cytochrome c oxidase, lysyl oxidase, p-hydroxyphenyl pyruvate hydrolase, tyrosinase, dopamine beta hydroxylase, and Cu-zinc superoxidase dismutase (Cu, Zn-SOD). Copper is found in oysters, liver, nuts dried fruit, whole grains and natural water. Copper prevents the damage caused by free radicals by reducing hydroperoxides formed.

### 2.5. Iron

Iron falls under trace mineral category that takes part in many biological processes in DNA and protein synthesis. It works as an important factor in haemoglobin, cytochrome and in enzymes for transportation and storage. Deficiency leads to fatigue, irritability and dizziness. Many studies found that iron acts as antioxidant by forming complexes with copper and flavonoids and scavenges the free radicals formed.<sup>9</sup>

The presence of antioxidants in foods were assayed globally by estimating oxygen radical absorbance capacity

(ORAC), ferric reducing antioxidant power (FRAP), 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2' – azinobis (3-ethylbenzothiazoline-6-sulphonic acid, ABTS) and microsomal lipid peroxidation(MLP).<sup>10,11</sup>

### 3. Conclusion

Thus, consumption of fruits and vegetables on daily basis will help to maintain the health of the population. The addition of natural antioxidants in foods will help to overcome deleterious effects caused due to synthetic preservatives. Long term use of synthetic antioxidants causes skin allergies, cancer, gastrointestinal tract diseases, DNA damage and premature senescence. Thus, antioxidants play a significant role in living organisms.

### 4. Source of Funding

None.

### 5. Conflict of Interest

None.

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**Cite this article:** Lalita A, Oviya Nilaa M K. Dietary antioxidants: An overview. *IP J Nutr Metab Health Sci* 2024;7(4):156-158.