# **Antioxidant and Health**

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Evidences have accumulated that the major cause of the degenerative diseases in the body are free radicals. Freeradicals have been implicated in the causation and progress of several diseases such as coronary heartdisease, ageing, cancer, parkinson's, disease, alzheimers, muscular, dystrophy, respiratory disease etc.

### Free Radicals:

Free radicals are defined as any species capable of independent existence that contains one or moreunpaired electrons. They are denoted by superscript dot ("). Free radicals are highly reactive, energetically unstable, have a very short life span. They create a chain reaction and thus produces the damage called oxidative stress. (Maxwell, 1995). Free radicals reactwith DNA, producing strand breakage, mutationsleading to various diseases and ruining the quality of life. Major free radicals produced in the body are hydroxyl radical (OH), superoxide radical (02), nitric oxide radical (NO) and nitrogen dioxide (NO2). Oncegenerated they attack other molecules and leaves behinda legacy in the form of propogating free radical chain reaction.

Free radicals originate either endogenously or exogenously. Endogenously, they are produced inside the body during the process of various biochemical reactions Exogenously, free radicals originate-as components of pollutants such as industrial fumes, smoke from diesel and petrol engines, cigarette smoke, indirectly through the metabolism of certain solvents, pesticides preservatives etc. Even drugs like paracetamol may exert toxic effects by promoting freeradical formation during their metabolism. Also exposure to radiation i.e. x- rays, ultra violet and gamma rays can lead to the production of free radicals (Youngson,2008). By virtue of low specificity and high reactivity, free radicals have the potential for-indiscriminate damage to biomolecules such as protein, carbohydrate, fatty acids, DNA, RNA etc. They disrupt the equilibrium of biological system by damaging their major constituent molecules leading eventually to celldeath. (Rao, 2002).

### **Antioxidants:**

The destructive effect of free radicals on tissues and organs can be effectively combated by antioxidants. Antioxidants can be defined as substances whose presence significantly inhibits or



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delays the rate of oxidation of the biomolecules. The body develops its own antioxidant defence mechanism with the help of endogenous and exogenous antioxidants which work at the molecular level to protect the body from the damaging effect of free radicals. Antioxidants can be classified into enzymatic and non-enzymatic according to their nature and action.

### **Enzymatic Antioxidants:**

Enzymatic antioxidants are endogenous in nature and are truly the scavengers of free radicals. The important antioxidant enzymes are superoxide dismutase (SOD); catalase and glutathione peroxidase.

a) Superoxide dismutase (SOD):- SOD converts two superoxide radicals to molecular oxygen and hydrogen peroxide.

b) Catalase :- It is one of the most active enzymes known. It has an enormous capacity to metabolize hydrogen peroxide produced by superoxide dismutase This reaction is called catalytic reaction. Thus catalase enzyme exerts a protective effect by Decomposing

c) Glutathione Peroxidase:- Glutathione peroxidase, a selenium dependent enzyme detoxifies hydrogen peroxide to water. The reduced glutathione is converted to oxidized glutathione. The reduced glutathione can be regenerated by the enzymeglutathione reductase utilizing NADPH. The hexose monophosphate shunt is the major source of NADPH. (Satyanarayana and Chakrapani, 2006)

Thus, all the antioxidant enzymes, work in conjugation at the molecular level in vivoand help to protect cell membranes, lipoproteins, DNA and RNA from the damaging effects of free radicals. But, in todays world of pollutants and chemicals, these endogenous antioxidant enzymes are overwhelmed by the excess free radicals and thus the body needs more exogenous antioxidants to protect itself.

#### Non enzymatic Antioxidants:

Non enzymatic antidotes are the dietary antioxidants which are further subdivided into nutrient antioxidants and non- nutrient antioxidants.

### a) Nutrient antioxidants:

These are the micronutrients of dietary origin such as Vitamin E as they exhibit strong antioxidant functions, [Rory Collins, 2002]

Vitamin E in involved in many body many functions and its strong antioxidant property is established. It is very effective in preventing lipid peroxidation. It helps to protect important cell structures especially the cell membranes from the damaging effect of free radicals. Though vitamin E is primarily located in cell and organelle membrane where it exerts its maximum protective effect but it can also directly act on radicals and thus serves as an important chain breaking antioxidant.

[Nigel et.al. 1996] B carotene, also known as pro vitamin A is an effective antioxidant. It is a



crystalline compound which protect rigid membrane cells from the carcinogenic effects of free radical damage.

Vitamin C is a simpler compound than Vitamin E. Besides its basic function of synthesis of collagen, its antioxidant function of Vitamin C are well utilized to preserve the natural flavor and colour of processed fruit, fruit drinks | vegetables and dairy products. It efficiently scavenges a range of reactive oxygen species by acting on the first line of defence in the water soluble-compartment of cell. It mops up the superoxide radical, hydrogen peroxide and hydroxyl radical. Studies have suggested that 1000mg/ day of vitamin C is needed as a basic dose of for the prevention from free radicals. [Youngson, 2008].

### (b) Non Nutrient antioxidants:

During the last decade emphasis is on screening the environment for the beneficial effect of naturally occurring constituents from the plant. The dietary components initially regarded as nutritionally inert have now occupied an important designation due to their antioxidant properties. Evidences have shown that these non nutrients have established role in interrupting free radical chain reactions and thus shown on inverse relation with the degenerative diseases. (Halvorsen, et.al. 2002)

Non nutrients include carotenoids, phenolic compounds, lycopene, curcumin, hesperidin, flavonoids and catechins.

Carotenoids are the natural substances with lipophilic properties. About 500 different carotenoids have been identified. Among them, vilamin B carotene is the most important but others have also established antioxidant property. Lycopene, found in tomatoes, is a carotenoid which is fat soluble. These pigments impart yellow or green color to fruits and vegetables and also serve as antioxidants. Besides these, there are other non-nutrients such as curcumin found in turmeric which is a potent anticarcinogen and antimutagen (Polasa et. al.2004) Hesperidin found in oranges and lemon, catechins in green tea are other important antioxidants.

During the last decade, interest has arisen a lot in phenolic compounds, Examples are flavonoids, cinnamic acid and anthocyanins which are ubiquitously found in plants. Common phenolic compound that are isolated from plants are Eugene (oil of cloves), anethole (oil of aniseed), vanillin (Oil of vanilla bean), thymol (Oil of Thyme). Synthetic phenolic compounds such as BHA (butylated hydroxy anisole) and BHT (butylated hydroxy toluene) have been added to foods for decades to utilize their antioxidant property. The biological-effects of naturally occurring phenolic compounds are beneficial as they neutralize and stop the action of free radicals.

Flavonoids are the plant pigments creating a rainbow colors in fruits and vegetables. The important group of flavoroids are quercetin, kaempferol, myricetin, apigenin, luteolin and pelargonidin. Others are anthocyanins, flavonols, flavones, catechins and flavonones. Over 4000 flavonoids have been discovered in nature. They also contribute to the flavor of some citrus fruits. Peels of oranges, lemons and grapefruit contain a wide range of flavonone glycosides. Epidemiological studies have suggested

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that high consumption of flavonoids was associated with lower CHD incidence and degenerative diseases (Knekt, et.al. 2002)

### Sources of antioxidant flavonoids:-

flavonoids have gained their due importance in the field of antioxidants. Today thebenefit of these dietary components in reducing the incidence of various degenerative diseases has been recognized. The rich sources are discussed below:-

### a) Tea/Coffee:

Tea and Coffee, the most common beverage of the world have been found to possess high antioxidants. Very high levels of phenolic compounds and flavonoids have been reported in black tea and coffee. (Nair and Nagar, 1997).Studies have shown that green tea is a better source of flavonoids than black tea. This is due to the oxidation of polyphenols that takes

place during fermentation process in black tea and destroys some of the flavonoids while green tea goes through steaming step early in the processing cycle which destroys the enzymes which oxidize the leaves. Hence the potential benefits comes more from green tea as compared to black tea. (Murray, 1996)

### b) Spices:

Variety of spices have been used in India to provide flavour to food. They alter the lipid peroxidation level to a beneficial extent and protect various tissues by preventing the formation of unwanted free radicals. masala, which is a mixture of all spices in a 'definite proportion' have been found to have high content of phenolics and flavonoids .Other spices like cinnamon, red chilli powder, clove also have high of flavonoids (Nair and Nagar, 1997). Though spices have high amount of flavonoids but they cannot be considered to be a very good source as the consumption amount is very less.

### c) Fruits and Vegetables:

Fruits due to their large serving size and mass consumption provides significant amounts of dietary antioxidants and increases the defence mechanisum of the body. Guava and amla due to their high vitamin C content and high flavonoids content are rich in antioxidants (Nair and Nagar 1997).

### d) Red Wine:

In red wine, high concentration of antioxidants arefound more than the fruit juices. This is attributed to the fermentation step by crushing the grapes, skins and seeds altogether. Grape seeds in particular contain large amount of flavonoids substances known as proanthcyanidin, Red wines showed a significant decrease in total cholesterol as well as in LDL in subjects having high cholesterol. (Srilakshmi, 2006)

Each antioxidant has its optimum range of action and that several different antioxidants are needed



to ensure comprehensive protection. Besides, healthy intake of antioxidants there should be avoidance of smoking, good weight control, low intake of saturated fats, exercise and plenty of vegetables and fruits.

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