

# Health Benefits of Vegetarian Foods against Oxidative Stress and its Harmful Effect: A Review

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## Abstract

As a result of defense mechanism and as by-products of cellular metabolic processes which utilizing oxygen in human body, certain molecules called reactive oxygen species (ROS) and reactive nitrogen species (RNS) are normally produced. Later these molecules are converted into free radicals in the body. Many factors are associated with the production of free radicals viz. smoking, drinking alcohol, high fat diet, too much sun exposure, existence of pollutants in the air and even excessive much exercise and stress. Exogenous sources of ROS include asbestos, crystalline silica, coal, diesel, chromium, bleomycin, herbicides, nitric oxide, ozone, radiation, cigarette smoke. Free-radical mechanisms may cause several human diseases including cancer, atherosclerosis, malaria, rheumatoid arthritis and neurodegenerative diseases. Superoxide radical ( $O_2^-$ ) and hydrogen peroxide ( $H_2O_2$ ) are known to be generated in the brain and nervous system *in vivo*. When these free radicals are produced in excess, they can cause tissue injury. However, tissue injury can itself cause ROS generation, which may contribute to a worsening of the injury. ROS are involved in cell signaling, gene transcription, aging and enzymology. A variety of cancers generate ROS as well as diabetes and pulmonary conditions ROS generation is also associated with oxidation of lipoproteins.

**Keywords:** Antioxidant; Oxidative stress; Phytochemicals.

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## Introduction

Antioxidants are of interest to food industry because they prevent rancidity in food caused by oxidation of fat. Some antioxidant agents are usually added while preserving the food. These agents prevent the oxidation in food and rendering it in a fit for human consumption. Antioxidants are also of the interest to clinicians since they may help to protect the human body against damage by Reactive Oxygen Species (ROS). It has been shown that free radicals including reactive oxygen species like superoxide ( $O_2^-$ ), hydrogen peroxide ( $H_2O_2$ ) and hydroxyl radical ( $OH\cdot$ ) are known to be generate in many organs ( brain and liver ) as a product of normal metabolism and by radiation

internally, they are formed during  $O_2$  metabolism and lipid peroxidation. The purpose of antioxidant in physiological setting is to prevent ROS concentration from reaching a high level within a cell that may cause damage (Imlay, 2003).

Antioxidants act as protective agents against aerobic organism cell damage which is induced by ROS or other free radicals (Hallowell, 1997). The antioxidants are classified into two categories due to their function, enzymatic and non-enzymatic antioxidants (Silva, 2006). The antioxidant properties of vitamin C may stabilize folate in food and in plasma; increased excretion of oxidized folate derivatives in humans with scurvy has been reported (Stokes *et al.*, 1975).

## Sources of antioxidants in human body

The body is endowed with complex antioxidant systems, which include exogenous antioxidants derived from the diet and endogenous antioxidants formed in the body (Young *et al.*, 2001). Cellular structure of human body itself provides natural defense against oxidative stress. There are two types of antioxidant defense systems exist in the human body i.e., enzymatic and non-enzymatic.

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### *Enzymatic Cellular antioxidants*

Super-oxide dismutase, glutathione peroxidase, catalase and Glutathione transferases are the enzymes involved in neutralizing the free radicals produced in the human body (Schafer FQ et al, 2001).

### *Non-enzymatic*

Tocopherol, thiols, vitamins viz. vitamin C and  $\beta$ -carotene, minerals viz. selenium, metals, phytochemicals and phenolic compounds etc. are the compounds involved in free radicals neutralizing reaction.

Among these all vitamin C,  $\beta$ -carotene, tocopherol, selenium and phenolic compounds such as flavonoids, anthocyanins, condensed tannins, lignans, cinnamic acids are of diet origin (Miller *et al.*, 1995). These antioxidants may act at different levels in the oxidative process e.g. by scavenging initiating radicals, binding metal ions, scavenging peroxy radicals or by removing oxidative damaged biomolecules and other types of action.

### *Potential of fruits and vegetables against oxidative stress*

Antioxidants refer to any substance that delays or inhibits oxidative damage to a target molecule. Lipids, proteins, nucleic acids, and carbohydrates are potential targets of oxidative damage. Antioxidants protect the target sample by scavenging oxygen-derived species, minimizing the formation of oxygen-derived species, binding metal ions, replacing damage to the target, and destroying badly damaged target molecules and replacing them with new ones. Antioxidants are largely found in plant foods chiefly in fruits and vegetable. These molecules neutralize the free radicals by donating an electron and reduce the incidence of chronic diseases and health risk related to the aging. Free radicals contain lots of energy and are reactive, unstable molecules. They contain only one electron in their outermost shell and need a second one to become stable (Halliwell *et al.*, 1995), which is provided by antioxidant. These free radicals may oxidize nucleic acids, proteins, lipids and DNA and can initiate degenerative disease.

### *Antioxidants present in Whole-Grain Cereals*

Whole grain possess a range of antioxidant compounds that can complement those present in fruits and vegetables as cereals contribution in our diet is higher comparing with fruits and vegetables. Major phytochemicals in cereals include phytosterols,

tocols, dietary fibers (mainly beta-glucan), lignans, alkylresorcinols, phytic acid,  $\alpha$ -oryzanol, avenanthramides, cinnamic acid, ferulic acid, inositols and betaine (Slavin J 2003, Jones JM. *et al.* 2004, Adom KK. *et al.* 2003). Avenanthramides in oats and have high antioxidant activity and a one serving of an oat meal could contribute to overall antioxidant potential of the daily diet which is greater than teas or fruit juices. Phytic acid of whole-grain cereals also acts as an antioxidant which chelates Fe and protect from free radical damage in the body. Bioactive compounds of wheat include Carotenoids, tocopherols, tocotrienols, phenolic acids, phytic acid, phytosterols and flavonoids (Zieli  $\text{\AA}$ . *et al.* 2000, Yu L, Zhou k and Parry J.W. 2005). These compounds are mainly found in bran i.e. outer most portion of the grain. It was found that, Ferulic acid is a predominant phenolic acid in wheat bran and it contributes around 99-231 $\mu$ g/g (Zhou K, Su L, Yu LL .2004). Variety wise differences in antioxidant compounds are observed. Generally red variety of wheat possess high amount of antioxidants compared with white variety. Rice contain antioxidant compounds vitamin E and  $\alpha$ -Oryzanol. Content of  $\alpha$ -oryzanol in rice bran is 10 times that of vitamin E (Xu Z. *et al.* 2001).

### *Antioxidants in nuts and oilseeds*

Numerous studies have shown that nuts improve LDL to HDL ratios, thereby reducing inflammation which is associated with risk of cardiovascular disease. Together with favorable fatty acid profile, they also contain other bioactive compounds that give positive effects on cardiovascular health (Kris-Etherton *et al.*, 2008). Other phytochemicals includes tocopherols and phytosterols, flavonoids, stilbenes, and resveratrol, as well as ascarotenoids and arginine. The total phenolic constituents contribute to the total antioxidant capacity of nuts. The combination of functional ingredients present in nuts and rich nutritional composition makes them potential functional foods. It has been studied that the phenolic compounds of almonds act as antioxidants by interfering an activity of free radicals and chelating agents (Heim *et al.*, 2002).

### **Conclusion**

Each food has its own health benefits but when it comes to vegetarian foods, it is proven that, vegetarian foods such as fruits, vegetables, cereals, nuts are rich source of all essential nutrients with additional benefit of providing valuable phytochemicals to fight

against oxidative stress. Western countries are adopting a vegetarian as these foods have potential health benefits. Although, Non-vegetarian foods supply good quality of protein, there are lacking in functional properties. Overall health benefits of vegetarian diet helps in combating number of degenerative diseases.

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