

## Review Article

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# Antioxidants, its role in preventing free radicals and infectious diseases in human body

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### Abstract

Recent research on herbal field reports various ailments associated with free radicals. The risk of ailments because of oxidative stress increases due to undesirable way of life, exposure of natural and synthetic chemicals, cigarette smoking, medications, stress and so on. Cancer prevention agents are the substances which can search free radicals and help diminish the frequency of oxidative pressure induced harm. The main sources of antioxidants are vitamins, fruits, minerals, plants and vegetables. The functions of antioxidants are to neutralize the effect of reactive oxygen species (ROS) and prevent various diseases such as cancer, diabetes and cardiovascular diseases. The presence of antioxidants can be evaluated by various methods but the cheapest and easiest available methods are 1, 1-diphenyl-2-picrylhydrazyl (DPPH), total antioxidants capacity (TAC), total phenolic contents (TPC), reducing power (RP) and ferric reducing antioxidant potential (FRAP) methods. This review generally discusses the information related to the antioxidants and their role in changing the free radicals into neutral or less reactive species. It also discusses the role of antioxidant enrich sources in decreasing the risk of different human diseases.

**Keywords:** Antioxidants; Free radicals; Oxidation; Prevention; Species

### Introduction

Antioxidant is a substance, present in small concentrations in body that helps in preventing the oxidation of substrate and plays a major role in the defense mechanism of body against reactive oxygen species [1-4]. It is reported that an antioxidant delays, inhibits or eliminates oxidative damage of targeted molecules. Antioxidants can prevent

oxidation of substrates even at low concentration and perform various biological roles in an animal's body, while in plants, it functions as radical scavenger. Various types of antioxidants are found in nutritional sources such as fruits, spices, vegetables, herbs, tea etc. In animal body, they act as free radicals scavengers [5, 6]. Antioxidants thus play a crucial role in the defense against free

radical damages, which are detrimental for animal's physiology. Systematic uses of fruits and vegetables with anti-oxidative properties have been reported in the control of chronic diseases [7]. Diet rich in antioxidants has a far reaching health benefits in the long run [8, 9]. One such example is the use of citrus fruits, which is rich in vitamin C and have large amount of natural antioxidants that have a number of physiological benefits. In addition, blueberries, grapes, strawberries, spinach, red beans etc. are known for their antioxidant properties and are recommended to be included in the diet [10, 11]. In addition, fruits such as jackfruits are good sources of vitamins (C, A) and phenolic components with antioxidant properties [12, 13]. There are a large number of other fruits and vegetables that serve as source of various antioxidants.

#### **Various types of antioxidants**

There are various types of antioxidants: exogenous present in food are called dietary antioxidants, found in fruits are natural products, produced in the body are endogenous antioxidants and produced synthetically are synthetic antioxidants, play a significant role in maintaining animal physiology.

#### **Dietary antioxidants**

Dietary antioxidants are used to prevent the process of oxidation, chemical reaction promoted by reactive oxygen species such as oxygen peroxide, affecting the wellbeing of living organisms by free radicals. Antioxidants such as tocopherols, acrobats and carotenoids are well known examples of dietary antioxidants which play an important role in the treatment of chronic infections [14]. Amongst the other antioxidants are vitamins (C, E), carotene,  $\beta$ -carotene and carotenoids like lycopene and lutein [15]. In extracellular fluids, water-soluble antioxidant like vitamin C is considered to be the most important antioxidant. Considering

the aqueous phase, it is suitable for neutralizing reactive oxygen species before the instigation of lipid peroxidation. Vitamin E is one of the major lipid soluble antioxidant having a role in cell membrane repair by preventing oxidation of membrane lipids [16]. B-carotene protects fat-rich tissue by preventing their oxidation thus serving as an antioxidant and is known to function along with vitamin E [17]. Flavonoids antioxidants in plants protect them from different environmental pressures, whereas in animals, they act as anti-inflammatory, anti-viral, anti-aging and anti-cancer agent [18-21].

#### **Synthetic antioxidant**

It is also an important type of antioxidant that is chemically manufactured and then added to the food as preservatives to inhibit fat oxidation [22]. These antioxidants are divided into two main groups based on their method of action: essential antioxidants and secondary antioxidants. The main antioxidants are more important which stop the creation of free radicals during oxidation. They consist of different types.

#### **Natural antioxidant**

Natural antioxidants are the innumerable ingredients of fruits and vegetables that have attracted much scientific attention [23, 24]. Natural antioxidants are created in all parts of plants and nutrients, because they live under continuous oxidation stress from free radicals and ROS. In this case, different tissues have produced antioxidant systems to manipulate free radicals, lipid oxidation catalysts, oxidation intermediates and secondary collapse yields [25-28]. These antioxidant mixtures consist of phenolic acids, carotenoids, tocopherols, flavonoids that can obstruct  $\text{Fe}^{+3}$  induced oxidation, clean free radicals and serve as metabolites [29, 30]. Spices and herbs are used in special foods for their flavor and in medicinal mixtures for their biological effects, which often involve large concentrations of phenolic compounds with strong hydrogen activity [31, 32].

Natural sources like fruits, vegetables and meats are noted to have all antioxidants. There are many natural antioxidants common to daily foods such as mostly vitamin A (carotenoids), vitamin E (tocopherol), vitamin C (ascorbic acid) various polyphenols including flavonoids, lycopene (of carotenoids), anthocyanins and coenzyme Q 10, recognized as Ubiquitin, a form of protein.

### **Endogenous antioxidants**

Along with nutritional antioxidants, the health depends on many self-defense mechanisms for defense against the destruction of cells caused by free radicals. The antioxidant enzymes SOD, catalase, peroxidase and glutathione act on the metabolism of poisonous intermediates and need micronutrients like Fe, Se, Zn, Cu and Mn to obtain the best catalyst activity. It has been recommended that adequate dietary intake of these rare metals may control the efficacy of these mechanisms to protect antioxidants [33]. Glutathione, an antioxidant soluble in water which is produced from glycine, glutamate and cysteine amino acids, reduces the types of reactive oxygen like lipid peroxides and also plays a main role in the biological metabolism. Liver when exposed to foreign matter leads to oxidation reactions via the higher regulation of purification enzymes, i.e. and the various cytochromes P-450 with oxidase function. As long as any organism confronts exceptional levels of alien organisms, additional glutathione is used for conjugation (a major phase in detoxification), making it less helpful as an antioxidant. It is suggested through research that glutathione and ascorbic acid (Vit-C) work collectively to reduce free radicals and need to have a precise effect on each other [17]. Lipoic acid, another important internal antioxidant which is classified as thiol or pythol, is a sulfur particle known to be involved in the reaction that stimulates the removal of oxidized carboxylic of alpha-keta

acids, such as pyruvate and alphaketoglutarate, in the Krebs cycle. Lipoic acid may also be used as an antioxidant resulted by mixing with the mass of the congestion. Research also stated that Lipoic acid has little consequence on other antioxidants [34].

### **Exogenous Antioxidants**

A type of antioxidant that can be derived from natural bases such as vitamins (flavonoids, anthocyanins, some mineral compounds) as well as synthetic compounds, such as butyl hydroxyanisol, butyl hydroxy, tuline, galate, etc [35]. There is an increasing interest in antioxidants, especially in those that aim to prevent the toxic effects recognized by free radicals in the human body as well as the degradation of fat and other nutrient components [36].

### **Source of Antioxidants**

The main sources of antioxidants are vegetables, fruits, fruit juices, peroxidase, polyphenols, vitamins, amino acids, minerals and many enzymes are the basic sources of antioxidants, but fruit and vegetable juices, beverages and hot drinks contain large amounts of antioxidants, vitamin C, alpha-carotene, Maylard reaction products, vitamin E and lycopene [37]. It has been found that drinking fruit juices, drinks and hot drinks reduce diseases and deaths caused by degenerative diseases [38-42]. The trends in epidemiological studies are that fever fruits, vegetables and processed foods ensure greater safety against the growth of ailments produced by oxidative stress like type 2 diabetes, obesity, cancer, cardiovascular disease and cataract due to high blood pressure. The reason for their health- building effect is the presence of prominent antioxidants [43].

### **Function of antioxidants**

The FDA (Food and Drug Administration) describes antioxidants as food compounds that are used with food for diseases prevention [44].

Antioxidants play an important role in the preventive inspiration practiced by plant foods [45-47]. Recognize that regular consumption of vegetables and fruits reduces the risk of long-term illness [48]. Studies have found that a rich antioxidant diet has a very positive long-term health effect [49]. Recently, it has been found that antioxidants play vital role in decreasing radicalism, oxidative stress, cancer prevention, heart disease and longevity [50]. All antioxidants act as a team player, and an antioxidant system is responsible for preventing the devastating effects of free radicals, as well as toxic products from their breakdown. However, the primary role of antioxidants is to control the amount of free-radical formation in a mirror system where the deficiency of a component affects the effectiveness of others [51]. The main function of antioxidants is to reduce the amount of oxidation of body fat and oils. The fourth method is to add the fat to the antioxidants. This method is the composition of a compound or compound between the fat and the antioxidants. Among the food ingredients that fight against prolonged diseases, much attention has been paid to phytochemicals, and plant-derived molecules are capable with intact antioxidant power. The cumulative and synergistic activities of biologically active molecules found in plant foods are responsible for their antioxidant properties.

#### **Function of vitamin C**

The protective functions or productive effect of vitamin C is the treatment of various types of cancer such as lungs, breast, oral cavity, pancreas, rectum and stomach [51]. In difficult circumstances, the adrenal glands respond by secreting the hormones that start or activate the "fight or escape" reaction. It has been determined that 200mg of vitamin C a day may reduce the amount of stress hormones. Stress destroys the immune system. Heavy doses of vitamin C improve

the number of antibodies that fight germs as well as bugs in restrained and resting mice, while increasing the number of antibodies that are innumerable in uncompressed mice [52].

#### **Vitamin E**

Vitamin E, a fat soluble vitamin, is one of the most important antioxidants [53, 54]. The main role of tocopherol as an antioxidant is to break the chain of free radical. Resultantly, the phenolic H atom is transferred to a peroxy fatty atom converting it into lipid hydrogen peroxide and vitamin E radical [55]. Vitamin E is the most powerful antioxidant that recommends oxidative stability to red palm olein (RPO) and also helps to retain the carotenoids and other parameters of excellence to authenticate the quality of oil [56]. Vitamin E penetrates radical intermediates peroxide in fatty peroxides and it is responsible for protecting polyunsaturated fatty acids (PUFA) in the cell membrane and Low Density Lipoprotein (LDL) against phospholipid peroxidation. Vitamin E is recommended for a variety of purposes from aging delay to healing of sunburn. The different functions that maintain the normal state of cells and provide their physical form of skin and tissues protect red blood cells (RBC,s) and augment immunity. Significant sources of tocopherol (vitamin E) consist of green leafy vegetables, wheat germ and seeds whole grains vegetable oil and fish liver oil.

#### **Beta-carotene**

It has a powerful antioxidant property used to neutralize free radicals as well as reactive oxygen molecules actually responsible for harmful grease in cell membranes as well as genetic material, which can lead to cardiovascular disease and cancer [57]. Till now, the constructive properties of beta-carotene and other carotenoids in humans were not decided to be the consequence of their antioxidant potential. The importance of it for human health is the deactivation of

ROS, preventing diseases like cancer and cardiovascular disease, is not obvious. Studies in the laboratory show that carotenoids may also inhibit fat oxidation in certain cases. Additionally, anti-atherosclerosis property may be present in beta carotene however, they seem to be more complex in the human body [58].

### **Selenium**

Selenium, a main element, plays high role in curing human beings through its antioxidant potential. Certainly, it is a specific ingredient needed in the formation and function of approximately 20-40 enzymes, most of which support to stop cellular harm from natural by products to the process of oxygen metabolism, called reactive oxygen species (ROS) and free radicals [59, 60]. The systematic role of the immune system needs selenium which also have antiviral properties [61, 62]. Special influences on inflammatory actions are among other important events known for selenoproteins [63].

### **Polyphenol antioxidant**

Recent evidences strongly support the contribution of polyphenols in the prevention of cardiovascular diseases, cancers and also suggest a key role in the prevention of degenerative neuropathies as well as diabetes [64]. An important development has been made in the field of heart disease, and it is now proven that some polyphenols, administered as enhancements or with food, improve health conditions, as evidenced by the number of vital markers closely associated with cardiovascular risk [65, 66]. Epidemiology tends to confirm the defensive effects of polyphenols against cardiovascular disease.

### **Glutathione**

Glutathione is said to protect cells from toxic substances like free radicals. The glutathione produced in human body is due to three important amino acids like cysteine, glycerin and glutamic acid. The various food sources consist of large quantities of naturally

occurring glutathione from asparagus, squash, grapefruit, potatoes, melons, plums, squash, spinach, cauliflower, etc. Spices, meat and foods that produce sulfur containing amino acids (such as eggs) are the ideal sources for upholding and enhancing vital levels of glutathione [67].

### **Peroxidase**

A type of enzyme found particularly in herbs as well as in leukocytes that contain complex protein with hematinic groups which can stimulate oxidation of several constituents. The main sources of peroxidase consist of radish root, soybean, turnip, fruit and mango fruit [68].

### **Flavonoids**

Flavonoids help in activating the potential of antioxidants. Furthermore, they also assist in cellular health and proper growth all over the body. It also works with vitamin C in order to reduce oxidative stress and especially the water part of the cell and can also reduce certain effects of aging. The number of unique flavonoids over 4000 can be more effective when using multiple types together. The main food sources are cranberries, cabbage, beet, black and red grapes, oranges, berries, grapefruit, lemon and green tea [69].

### **Conclusion**

Antioxidants play a crucial role in the defense system of living organisms against free radical impairment and sustaining optimal health. Systematic utilization of fruits and vegetables with antioxidant properties have been identified in reducing diseases in long-term and rich antioxidant diet has a very long-term healthy effect. Thus, fruits and vegetables are the best natural source of antioxidants needed for the wellbeing of human life by reducing free radicals. Daily consumption of these fruits and vegetables in sufficient quantities ensures protection against a number of illnesses such as cancer, heart disease, obesity, kidney disease, stress, high blood pressure, type 2 diabetes, aging, anti-allergic and viral infections.

**Authors' contributions**

Conceived the idea: M Suleman & M Ayub,  
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 Samiullah, Wrote the paper: M Suleman,  
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