

The positive role of antioxidants on body immunity: An overview

Rawaa Hadi Shareef, Zahraa Fathi Sharba, Evan Noori Hameed¹

Departments of Pharmacology and Toxicology and ¹Clinical Pharmacy, College of Pharmacy, University of Kufa, Kufa, Iraq

Abstract

The immune system is a complicated system; it is consisted from network of specialized organs, tissues, cells, proteins, and chemicals which it has the function to protect the host from various types of pathogens such as bacteria, virus, fungi, and parasite in addition to cancer cells. Antioxidants are defined as agents that can prevent the damage that is caused by free radicals through scavenging of them. They decrease the damage by neutralizing to the free radicals before they attack any of the cells and can prevent lipids, enzymes, proteins, carbohydrates, and DNA damage.

Keywords: Adaptive immunity, antioxidant, immune system, innate immunity, vitamins

INTRODUCTION

Immune system

The immune system is a complicated system that contains many of organs, cells, and molecules as in Figure 1^[1] which have function to maintain the homeostasis of the body and responding to aggression. There are two types of immunity; innate and adaptive immunity. The innate immunity represents a response which is fast and stereotyped response. This type of immunity consists of many cells like macrophages, neutrophils, dendritic cells, and natural killer (NK) cells. Phagocytosis, complement system proteins activation, mediator of inflammation releasing, and acute-phase proteins, cytokines, and chemokines synthesis, all these represent the main mechanisms in innate immunity.^[2]

On the other hand, the response of adaptive or acquired immunity differs from the innate immune response; it depends on the special type of cells known as lymphocytes in addition to soluble molecules produced by these cells. The most acquired response is characterized by the diversity of recognition and it has a memory and is considered as a special response, self-restraint. Despite that, the lymphocytes are considered as the main type of cells involved in acquired immune response, but there is another cell that can play a significant role in the activation and presenting the antigens that is associated with molecules of the major histocompatibility complex to T lymphocyte; these cells are antigen-presenting cells.^[3] The lymphocyte cell includes T

and B cells. The coordination of the immune response occurs by T cell through the production of cytokines, in addition to the production of antibodies by B cell stimulation and destroy antigen-displaying cells by signaling killer cells.^[4]

ANTIOXIDANTS

The production of free radicals is considered as a part of the metabolism, but the cells of the body are exposed to oxidants either from endogenous or exogenous sources in a continuous state. The antioxidant compounds play important role in maintaining the balance between oxidants and antioxidants.^[5] Oxidative stress represents the imbalance that occurs due to changing in the concentration of these compounds. Oxidative stress can cause cell and tissue destruction in different mechanisms: by causing damage to the biomolecules and components of cells, activation to the specific signaling paths, toxic product origination, altering the gene expression, and action of some enzymes in addition to disturb the normal mechanisms

Address for correspondence: Dr. Rawaa Hadi Shareef,
Department of Pharmacology and Toxicology, College of Pharmacy,
University of Kufa, Kufa, Iraq.
E-mail: rawaah.alsaabary@uokufa.edu.iq

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of cellular repair. For these causes, the oxidative stress associated with several chronic disease likes, cardiovascular diseases, diabetes mellitus, aging process, and cancer.^[6]

The antioxidant can be defined as a molecule which has the ability to prevent or lower the oxidation of macromolecules. The major role of antioxidants is to slow or cause a termination of these chain reactions by different ways, such as removal of free radicals or by causing inhibition to other oxidation reactions by being oxidized themselves. The antioxidant has different pathways for the defense such as blockage the production of free radicals, scavenging of oxidant products, converting the toxic free radicals into substances with low toxicity, blockage to the secondary toxic metabolites and mediators of inflammation production, and repairing the injured molecule.^[7] There are two types of antioxidants, exogenous and endogenous antioxidants; exogenous antioxidants can derive from natural sources such as vitamins, flavonoids, and some mineral compounds.

VITAMIN C

Vitamin C is one of the most important vitamins and acts as exogenous antioxidant; it protects the body from both types of oxidative stress; endogenous and exogenous.^[8] Vitamin C has wide activities that may play an important role in immune system defense. It is considered as the antioxidant that has a high activity because its ability to donate electrons readily. Hence, it protects essential biomarkers such as lipid, protein, carbohydrate, and nucleic acid from damage by oxidants that result from normal metabolism of cells and from exposure to a toxin or pollutant. Vitamin C also occurs to have a many of beneficial effects on the function of both innate and adaptive immune system cells; it stimulates the migration of neutrophil cells to the site of infection, enhances the processes of phagocytosis, and killing the microbes, enhance antibody generation. Also, it has the ability for preventing and treating respiratory infections by enhancing the function of numerous immune cells.^[9]

VITAMIN D

Vitamin D is, also acts as an antioxidant and has a role in activating of the immune system. The usual function of Vitamin D is the maintenance of the homeostasis of calcium and support the health of bones. Vitamin D was found to have an effect on both types of immunity. In innate immunity, Vitamin D can inhibit the production of some inflammatory cytokines by monocytes like interleukin-1, interleukin-6, interleukin-8, interleukin-12, and tumor necrosis factor- α .^[10] Also, it has an important effect on macrophage; the macrophages are known to recognize lipopolysaccharide which is a surrogate for bacterial infection through receptors called toll-like receptors. The engagement of these receptors leads to several of events that result in the production of peptides with powerful bactericidal activity such as cathelicidin and defensin-4.^[11] Vitamin D binds with VDREs genes for cathelicidin and beta defensin-4; it can cause transcription of these proteins. So, the process of cathelicidin and beta defensin-4 transcription depends

absolutely on the appropriate amount of Vitamin D.^[12]

While on adaptive immunity, Vitamin D has many of effects on cells within this system, it inhibits the proliferation of B cells, blocks the differentiation of B cell, and secretion of immunoglobulin.^[13] Also, this vitamin has the ability to suppress the proliferation of T-cell and cause their shifting from Th1 to Th2 phenotype and these effects cause a reduction in the production of inflammation cytokines such as interleukin-17 and interleukin-21, while its cause increasing in the production of anti-inflammatory cytokines such as interleukin-10.^[14]

VITAMIN E

Vitamin E is another vitamin, has antioxidant activity, is considered as the main fat-soluble antioxidant that causes a termination to the oxidation of polyunsaturated fatty acid through scavenging of peroxy radicals. Also, Vitamin E has the ability to inhibit the activity of protein kinase C, by increasing the dephosphorylation of protein kinase C- α through activation of enzyme called protein phosphatase A. So, the inhibition of protein kinase C by this vitamin results in many effects, like inhibition the aggregation of platelets and reducing the proliferation of many cells like monocytes, macrophages, neutrophils in addition to decreasing the production of superoxide in these cells.^[15,16] Also, Vitamin E acts on T-cell by increasing interleukin-2 formation and decreases the production of interleukin-4. Also, it increases B cell production of antibody response and increases NK cell activity and on macrophage, Vitamin E will be effected on prostaglandin-E2 production.^[17,18]

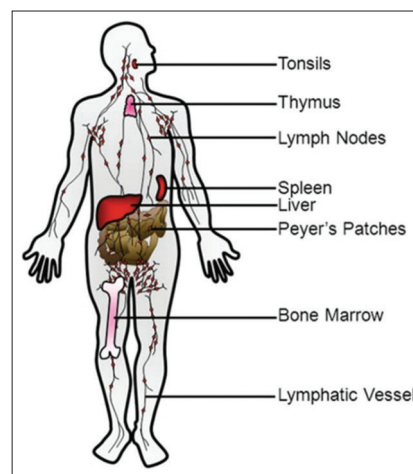


Figure 1: Human immune organ

Table 1: Various types of reactive oxygen species and equivalent neutralizing antioxidants

Reactive oxygen species	Neutralizing antioxidants
Hydroxyl radical	Vitamin C, glutathione, flavonoid
Superoxide radical	Vitamin C, glutathione, flavonoid
Hydrogen peroxide	Vitamins (C and E), glutathione, flavonoid
Lipid peroxide	Vitamin E, glutathione peroxidase, flavonoid

PHENOLIC COMPOUNDS

Phenolic compounds originate from plant origin and found in many types of foods and they have the ability to act as scavengers of free radicals. Polyphenols are found in several foods, but it was found that there is a difference in the amount and type of these compounds because of many factors like genetic factors, environmental factors in addition to processing conditions. Flavonoids are considered as the main type of phenolic compounds in plants, also they are considered as secondary metabolites of plants and exhibit their antioxidant activity by several mechanisms; they act as a scavenger for some reactive species such as superoxide, hydroxyl, and peroxy directly, also they act as chain-breaking antioxidants. Also, some of these compounds may bind to some of pro-oxidant metals like iron and copper and result in inhibiting the formation of free radicals, while instantaneously, they maintain their ability to scavenge these free radicals. Additionally, some of these compounds have the ability to increase the activity of antioxidant enzymes and stimulate the synthesis of antioxidant proteins.^[19]

GLUTATHIONE

Is an endogenous antioxidant defined as an antioxidant can be synthesized and produced in the body, glutathione is endogenous antioxidant and also can be obtained through diet. Glutathione is considered as an important antioxidant in the immune system for two causes; first, it protects the immune cells of the host through its antioxidant mechanism against different types of reactive oxygen species as in Table 1^[20], second, it provides the best working of immune system cells like lymphocytes and other cells.^[21] It is considered as an essential factor for the proliferation of T-cell, neutrophil phagocytic activity, and dendritic cell function.^[22] So, the decreasing of glutathione levels is associated with an increased susceptibility to infection and disease such as G6DP,^[23] cystic fibrosis,^[24] and influenza infection.^[25]

CONCLUSION

The immune system is a complicated system and it has many functions, but the most important function is the maintenance of the homeostasis of the body and responding to aggression. So, we must enhance the function of the immune system by different mechanisms like consumption of healthy foods which are rich in antioxidant substances, especially green vegetables and fruits.

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Conflicts of interest

There are no conflicts of interest.

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