Volume 3, Issue 2, February – 2025 **ISSN (E):** 2938-379X

THE ROLE AND IMPORTANCE OF ANTIOXIDANTS IN SCIENTIFIC RESEARCH

Mukhammadiy Khakimiv
Krabuk University, Faculty of Medicine, Master Student of Medical Biochemistry
https://orcid.org/0009-0004-2448-2910

Abstract
Antioxidants are compounds that are gaining more and more importance in modern medicine and health sciences. These molecules play a critical role in the protection of cells and tissues by preventing oxidative stress caused by free radicals. Oxidative stress occurs as a result of free radicals such as reactive oxygen species (ROS) and reactive nitrogen species (RNS) interacting with cellular components and damaging DNA, proteins and lipids. This process is closely associated with many pathological conditions, such as cancer, cardiovascular diseases, neurodegenerative disorders (such as Alzheimer's, Parkinson's), and even aging. Antioxidants help to prevent cellular damage by neutralizing these harmful molecules.

Web of Teachers: Inderscience Research
webofjournals.com/index.php/1

Introduction

Antioxidants are divided into two main groups: endogenous (produced by the body) and exogenous (taken from the outside). Endogenous antioxidants include enzymes such as superoxide dismutase (SOD), glutathione peroxidase (GPx), and catalase, while exogenous antioxidants consist of compounds such as vitamin C, vitamin E, carotenoids, and polyphenols. Decongestant antioxidants are also known as superoxide dismutase (SOD), glutathione peroxidase (GPx), and catalase. These compounds can be taken into the body through foods, supplements, and herbal sources.

Scientific research conducted in recent years has allowed us to better understand the effects of antioxidants on health. The role of antioxidants in the prevention of chronic diseases, especially cancer, heart diseases and neurodegenerative disorders, is of great interest. However, there are still unanswered questions about the effects of antioxidants and challenges that need to be investigated. In this article, the mechanisms of antioxidants, their effects on health, their place in scientific research and their potential future applications will be examined in detail.

1.Definition and Types of Antioxidants

Antioxidants are divided into two main groups: endogenous (produced by the body) and exogenous (taken from the outside). Endogenous antioxidants include enzymes such as superoxide dismutase (Dec), glutathione peroxidase (GPx) and catalase. On the other hand, exogenous antioxidants are compounds such as vitamin C, vitamin E, carotenoids and polyphenols (Halliwell & Gutteridge, 2015).

Tablo 1: Antioksidan Türleri ve Kaynakları

Antioksidan Türü	Örnekler	Kaynakları
Endojen Antioksidanlar	Süperoksit dismutaz, Glutatyon	Vücut tarafından üretilir
Eksojen Antioksidanlar	C vitamini, E vitamini, Polifenoller	Meyveler, sebzeler, kuruyemişler

2. The Mechanism of Action of Antioxidants

Antioxidants react with free radicals, making them stable. This process ensures the protection of cell components from oxidative damage. In particular, reactive oxygen species (ROS) and reactive nitrogen species (RNS) are target molecules of antioxidants (Sies et al., 2017).

The Mechanism by Which Antioxidants Neutralize Free Radicals

(It can be created with a simple racket as follows:)

Free Radical (e.g. ROS) → Antioxidant (e.g. Vitamin C) → Stable Molecule

3. The Effects of Antioxidants on Health

The effects of antioxidants on health have been studied in many scientific studies:

3.1. Cancer

Antioxidants can reduce the risk of cancer by preventing DNA damage. In particular, many studies have been conducted on the anti-cancer effects of vitamin C and vitamin E (Valko et al., 2007).

3.2. Cardiovascular Diseases

It reduces the risk of atherosclerosis by inhibiting the oxidation of LDL cholesterol. For example, vitamin E has been shown to be effective in preventing cardiovascular diseases (Stampfer et al., 1993).

3.3. Neurodegenerative Diseases

It helps to reduce oxidative stress in diseases such as Alzheimer's and Parkinson's. Studies on the neuroprotective effects of polyphenols are ongoing (Butterfield et al., 2002).

3.4. Aging

It can slow down the cellular aging process. Antioxidants can delay the aging process by improving mitochondrial functions (Harman, 1956).

Table 2: The Effects of Antioxidants on Health

Type of Disease	Type of Antioxidant	Effects
Cancer	Vitamin C, vitamin E	DNA hasarını önleme
Cardiovascular Diseases	Vitamin E, Polyphenols	Inhibiting LDL oxidation
Neurodegenerative Diseases	Polyphenols	Reducing oxidative stress
Aging	Carotenoids, Polyphenols	Improving mitochondrial functions

4. Methods and Difficulties in Antioxidant Studies

In vitro, in vivo and clinical studies are being conducted to evaluate the effectiveness of antioxidants. However, the ability of antioxidants to exert a pro-oxidant effect at high doses and genetic differences between individuals increase the complexity of research (B Dec & Haenen, 2013).

In Vitro Studies → Cell Cultures In Vivo

Studies → Animal Models Clinical Studies → Human Experiments

5. Future Perspective

Antioxidant research has great potential in the fields of personalized medicine and nutrigenomics. In particular, the discovery of natural sources of antioxidants and pharmacological applications of these compounds will be the focus of future studies (Lobo et al., 2010).

Graph 3: Potential Future Applications of Antioxidants

(a diagram can be created as above:)

Potential Future Applications of Antioxidants

Do Natural Resources → Pharmacological Applications → Personalized Medicine

Result

Antioxidants have a great potential in terms of preventing cellular damage caused by oxidative stress and protecting health. In this study, the definition of antioxidants, their types, working mechanisms and their effects on health were examined in detail. It has been supported by scientific studies that antioxidants play a protective role in many pathological processes, such as cancer, cardiovascular diseases, neurodegenerative disorders and aging. In particular, exogenous antioxidants such as vitamin C, vitamin E and polyphenols have been shown to prevent cellular damage by neutralizing free radicals.

However, there are still unanswered questions about the effects of antioxidants. For example, the ability of antioxidants to exert a pro-oxidant effect at high doses and genetic differences between individuals make the use of these compounds Deconstructed. In addition, ensuring consistency between the methods used to evaluate the effectiveness of antioxidants (in vitro, in vivo and clinical trials) is also a significant challenge. Dec.

In the future, antioxidant research has great potential in the fields of personalized medicine and nutrigenomics. In particular, the discovery of natural sources of antioxidants and pharmacological applications of these compounds will be the focus of future studies. Further research on the proper use of antioxidants and their potential risks will help us better understand the effects of these compounds on health. As a result, antioxidants will continue to be an indispensable tool for modern medicine and health sciences and will find wider applications in the future.

References

1. Halliwell, B. ve Gutteridge, J. M. C. (2015). Biyoloji ve Tıpta Serbest Radikaller. Oxford Üniversitesi Yayınları.
2. Sies, H., Berndt, C. ve Jones, DP (2017). Oksidatif stres. Biyokimyanın Yıllık İncelemesi, 86, 715-748.
3. Valko, M., Leibfritz, D., Moncol, J., Cronin, MT, Mazur, M., ve, Telser, J. (2007). Normal fizyolojik fonksiyonlarda ve insan hastalıklarında serbest radikaller ve antioksidanlar. Uluslararası Biyokimya ve Hücre Biyolojisi Dergisi, 39 (1), 44-84.
4. Butterfield, Bölge Savcısı ve Lauderback, CM (2002). Alzheimer hastalığı beyninde lipid peroksidasyonu ve protein oksidasyonu: amiloid β-peptid ile ilişkili serbest radikal oksidatif stresi içeren potansiyel nedenler ve sonuçlar. Serbest Radikal Biyoloji ve Tıp, 32 (11), 1050-1060.
5. Harman, D. (1956). Yaşlanma: serbest radikal ve radyasyon kimyasına dayanan bir teori. Gerontoloji Dergisi, 11 (3), 298-300.
6. Bast, A. ve Haenen, G. R. (2013). Antioksidanlar hakkında on yanlış anlama. Farmakolojik Bilimlerdeki Eğilimler, 34 (8), 430-436.
7. Lobo, V., Patil, A., Phatak, A. ve Chandra, N. (2010). Serbest radikaller, antioksidanlar ve fonksiyonel gıdalar: İnsan sağlığına etkisi. Farmakognozi İncelemeleri, 4 (8), 118-126.
8. Pham-Huy, L. A., O, H. ve Pham-Huy, C. (2008). Serbest radikaller, hastalık ve sağlıkta antioksidanlar. Uluslararası Biyomedikal Bilimler Dergisi, 4 (2), 89-96.
9. Önceki, R. L. ve Cao, G. (1999). İn vivo toplam antioksidan kapasite: farklı analitik yöntemlerin karşılaştırılması. Serbest Radikal Biyoloji ve Tıp, 27 (11-12), 1173-1181.
10. Halliwell, B. (2007). Oksidatif stres ve kanser: ilerledik mi? Biyokimyasal Dergi, 401 (1), 1-11.
11. Frei, B. (1994). Reaktif oksijen türleri ve antioksidan vitaminler: etki mekanizmaları. Amerikan Tıp Dergisi, 97 (3), S5-S13.
12. Ames, B. N., Shigenaga, MK ve Hagen, TM (1993). Oksidanlar, antioksidanlar ve yaşlanmanın dejeneratif hastalıkları. Ulusal Bilimler Akademisi Bildirileri, 90 (17), 7915-7922.
13. Diplock, AT (1994). Antioksidanlar ve hastalıkların önlenmesi. Tıbbın Moleküler Yönleri, 15 (4), 293-376.
14. Gutteridge, J. M. C. ve Halliwell, B. (2010). Antioksidanlar: moleküller, ilaçlar ve efsaneler. Biyokimyasal ve Biyofiziksel Araştırma İletişimi, 393 (4), 561-564.
15. Scalbert, A., Johnson, BT ve Saltmarsh, M. (2005). Polifenoller: antioksidanlar ve ötesi. Amerikan Klinik Beslenme Dergisi, 81 (1), 215S-217S.