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A BRIEF POSTULATION O FREE RADICALS AND ANTIOXIDANTS

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ABSTRACT

Free radicals are atoms or molecules with an unpaired electron, making them highly reactive. They are generated naturally during metabolic processes like respiration and energy production in mitochondria. External factors such as pollution, UV radiation, and smoking can also increase free radical production. Free radicals are unstable molecules that can damage cells in the body, contributing to aging and various diseases. Antioxidants are molecules that neutralize free radicals by donating an electron, thus preventing or reducing cellular damage caused by oxidative stress. They play a vital role in maintaining health and reducing the risk of chronic diseases. Understanding their role in health is essential to promote better well-being.

KEYWORDS: Antioxidants, Free Radicals, Oxidative Stress, Chronic Diseases.

INTRODUCTION

Free radicals and related species have attracted a great deal of attention in recent years. They are mainly derived from oxygen (reactive oxygen species/ROS) and nitrogen (reactive nitrogen species/RNS) and are generated in our body by various endogenous systems, exposure to different physicochemical conditions or pathophysiological states.

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The field of free radicals and antioxidants or 'redox biology', is fundamental to aerobic life. Aerobes constantly make reactive species, but modulate their actions by synthesizing antioxidants. This balance allows some reactive species to perform useful functions while minimizing oxidative damage. In general, dietary antioxidants are ineffective at modulating the 'redox balance' in humans. This helps to explain why, although oxidative damage contributes to the development and pathology of several human diseases, dietary 'antioxidant' supplements have limited efficacy in disease prevention.

FREE RADICALS

Free radicals, including reactive oxygen species, are molecules with one or more unpaired electron. For eg.

- Superoxide
- Hydroxyl radical
- Nitric oxide radical

Cells contain small structures called mitochondria, which work to generate energy in the form of adenosine triphosphate (ATP). Mitochondria combine oxygen and glucose to produce carbon dioxide, water and ATP. Free radicals arise as by-products of this metabolic process. External substances, such as cigarette smoke, pesticides and ozone, can also cause the formation of free radicals in the body

OXIDATIVE STRESS

Oxidative stress can occur when there is an imbalance of free radicals and antioxidants in the body. The body's cells produce free radicals during normal metabolic processes. However, cells also produce antioxidants that neutralize these free radicals. In general, the body is able to maintain a balance between antioxidants and free radicals.

When free radicals overwhelm the body's ability to neutralize them, oxidative stress occurs. This imbalance can lead to.

Cellular Damage: Free radicals can damage lipids, proteins, and DNA, impairing cell function.

Aging: Oxidative stress accelerates signs of aging, including wrinkles and reduced skin elasticity.

Chronic Diseases: Oxidative stress is linked to diseases like cancer, diabetes, cardiovascular diseases and neurodegenerative disorders (e.g., Alzheimer's).

Several factors contribute to oxidative stress and excess free radical production. These factors can include.

- Diet
- Lifestyle
- Certain conditions
- Environmental factors such as pollution and radiation

Uncontrolled oxidative stress can accelerate the aging process and may contribute to the development of a number of conditions. Although free radicals are produced naturally in the body, lifestyle factors can accelerate their production. Those include.

- Exposure to toxic chemicals, such as pesticides and air pollution
- Smoking
- Alcohol
- Fried foods

These lifestyle factors have been linked to diseases such as cancer and cardiovascular disease. So, oxidative stress might be a reason why exposure to these substances causes disease.

ANTIOXIDANTS AND FREE RADICALS

Antioxidants are substances that neutralize or remove free radicals by donating an electron. The neutralizing effect of antioxidants helps protect the body from oxidative stress. What makes antioxidants unique is that they can donate an electron without becoming reactive free radicals themselves. No single antioxidant can combat the effects of every free radical. Just as free radicals have different effects in different areas of the body, every antioxidant behaves differently due to its chemical properties. However, some antioxidants may become pro-oxidants, which grab electrons from other molecules, creating chemical instability that can cause oxidative stress. Like free radicals, antioxidants come from several different sources. Glutathione is an antioxidant naturally produced by cells.

Types

Endogenous Antioxidants: Produced naturally by the body (e.g., glutathione, superoxide dismutase).

Exogenous Antioxidants: Obtained from food or supplements (e.g., vitamins C and E, beta-carotene, selenium).

ANTIOXIDANT FOODS AND SUPPLEMENTS

Thousands of chemicals can act as antioxidants. Vitamin C and E, glutathione, beta-carotene, and plant estrogens called phytoestrogens are among the many antioxidants that may cancel out the effects of free radicals. Many foods are rich in antioxidants. Berries, citrus fruits and many other fruits are rich in vitamin C, while carrots are known for their high beta-carotene content. The soy found in soybeans and some meat substitutes is high in phytoestrogens. Natural compounds, especially derived from dietary sources provide a large number of antioxidants. Some beverages such as tea are also rich sources of antioxidants.

Dietary Sources of Antioxidants

Fruits	:	Berries (blueberries, strawberries), citrus fruits, grapes.
Vegetables	:	Leafy greens (spinach, kale), broccoli, carrots, tomatoes.
Nuts and Seeds:		Walnuts, sunflower seeds, almonds.
Beverages	:	Green tea, coffee, red wine (in moderation).
Spices and Herbs:		Turmeric, cinnamon, oregano.

HEALTH BENEFITS OF ANTIOXIDANTS

Neutralizing Free Radicals

Free radicals are byproducts of normal cellular processes and external factors like pollution, UV radiation, and smoking. Antioxidants stabilize free radicals, preventing cellular damage. Reducing Risk of Chronic Diseases.

Heart Disease

Antioxidants like flavonoids and polyphenols improve heart health by reducing inflammation and preventing the oxidation of LDL cholesterol.

Cancer Prevention

By protecting cells from DNA damage, antioxidants may lower the risk of certain cancers.

Neurodegenerative Diseases

Antioxidants such as vitamin E and polyphenols may slow the progression of diseases like Alzheimer's and Parkinson's.

Slowing the Aging Process

Antioxidants combat oxidative stress, which is a major contributor to aging, by protecting skin cells and other tissues.

Immune Support

Vitamin C and selenium boost the immune system by enhancing white blood cell function and reducing inflammation.

AYURVEDA, ANTIOXIDANTS AND THERAPEUTICS

Employing a unique holistic approach, Ayurvedic medicines are usually customized to an individual constitution. Current estimate indicates that about 80% of people in developing countries still rely on traditional medicine-based largely on various species of plants and animals for their primary healthcare. Ayurveda remains one of the most ancient and yet living traditions practiced widely in India. It has important role in bioprospecting of new medicines from medicinal plants, which are also rich sources of antioxidants.

INDIAN MEDICINAL PLANTS

Apart from the dietary sources, Indian medicinal plants also provide antioxidants which includes - Aegle marmelos (Bengal quince, Bel), Allium cepa (Onion), Allium sativum (Garlic, Lahsuna), Aloe vera (Indian aloe, Ghritkumari), Amomum subulatum (Greater cardamom, Bari elachi), Andrographis paniculata (The creat, Kiryat), Asparagus racemosus (Shatavari), Azadirachta indica (Neem, Nimba), Bacopa monniera (Brahmi), Camellia sinensis (Green tea), Cinnamomum verum (Cinnamon), Cinnamomum tamala (Tejpat), Curcuma longa (Turmeric, Haridra), Emblica officinalis (Indian gooseberry, Amlaki), Glycyrrhiza glabra (Yashtimadhu), Hemidesmus indicus (Indian Sarasparilla, Anantamul), Momordica charantia (Bitter gourd), Nigella sativa (Black cumin), Ocimum sanctum (Holy basil, Tulsi), Picrorrhiza kurroa (Katuka), Plumbago zeylanica (Chitrak), Syzigium cumini (Jamun), Terminalia bellarica (Behda), Tinospora cordifolia (Heart-leaved moonseed, Guduchi), Trigonella foenugraecum (Fenugreek), Withania somnifera (Winter cherry, Ashwagandha) and Zingiber officinalis (Ginger).

ANTIOXIDANT RESEARCH - MOST RESEARCH SHOWS FEW OR NO BENEFITS.

A 2010 study that looked at antioxidant supplementation for the prevention of prostate cancer found no benefits. A 2012 study Trusted Source found that antioxidants did not lower the risk of lung cancer. In fact, for people already at a heightened risk of cancer, such as smokers, antioxidants slightly elevated the risk of cancer.

Some research has even found that supplementation with antioxidants is harmful, particularly if people take more than the recommended daily allowance (RDA). A 2013 analysis Trusted Source found that high doses of beta-carotene or vitamin E significantly increased the risk of dying.

A few studies have found benefits associated with antioxidant use, but the results have been modest. A 2007 study Trusted Source, for instance, found that long-term use of beta-carotene could modestly reduce the risk of age-related problems with thinking.

RISKS OF EXCESS ANTIOXIDANTS

While antioxidants are beneficial, excessive intake through supplements can be harmful. Over-supplementation may:

1. Interfere with natural cellular processes.
2. Increase the risk of certain cancers.
3. Cause toxicity (e.g., excessive vitamin A can harm the liver).

CONCLUSION

In recent years there is an upsurge in the areas related to newer developments in prevention of disease especially the role of free radicals and antioxidants. Studies suggest that antioxidants cannot “cure” the effects of free radicals – at least not when antioxidants come from artificial sources. It is possible that free radicals are an early sign of cells already fighting disease, or that free radical formation is inevitable with age.

So it will be pertinent to examine the possible role of ‘free radicals’ in disease and ‘antioxidants’.People interested in fighting free radical-related aging should avoid common sources of free radicals, such as pollution and fried food. They should also eat a healthful, balanced diet without worrying about supplementing with antioxidants.

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