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Review Article

Role of Antioxidants in Breaking Stress- A Review

Dr. R V Rao Kummukuri, MDS[1*], Dr. Anuradha Uttam Lokare, MDS[2], Dr. Samira Aditya Kunapareddy, BDS[3], Dr. Vedatrayi, MDS[4], Dr. Shalini Singh, MDS[5], Dr. Rahul Vinay Chandra Tiwari, FOGS, MDS[6], Dr. Heena Tiwari, BDS, PGDHHM[7]

[1]Consultant in Oral Medicine and Radiology, Vijayawada Andra Pradesh, India
[2]Consultant Oral Pathologist, Mumbai, India
[3]RIMS Government Dental College and Hospital- Putlampalli Village, Kadapa, Andhra Pradesh, India
[4]Consultant oral and maxillofacial surgeon, T. Nagar Chennai, India
[5]Consultant Conservative Dentist & Endodontist, Mumbai, Maharashtra, India
[6]Assistant Professor, Department of Oral and Maxillofacial Surgery, Sri Sai College of Dental Surgery, Vikarabad, India
[7]Government Dental Surgeon, Chhattisgarh, India

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***Corresponding author:** Dr. R V Rao Kummukuri

Abstract

Antioxidant is a molecule which inhibits the oxidation reaction. The antioxidants terminate the chain reaction which is caused by the free radicals of oxidation reaction and thereby prevent the cell damage or cell death. Antioxidants are safe, efficacious and widely available. However, there is still a lack of randomized controlled trials in dental research limits the usage of antioxidants. This article highlights the significance of antioxidant therapy.

Keywords: Antioxidants, Free radicals, Oxidative stress.

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INTRODUCTION

The oxygen is a ubiquitous element and is a crucially important substance present on the earth for life of all the living organisms, especially for human beings. However, it can be both beneficial as well as harmful to life. Increasingly high concentration of oxygen can damage the tissues and are toxic in various ways. Although, the process of oxidation is a natural phenomenon for the generation of energy but it's by-products which are called "Free Radicals" can severely damage the healthy cells of the body [1]. The byproducts are generally unstable and are mostly reactive oxygen and reactive nitrogen species [1, 2]. These reactive species play a dual role as they are both beneficial as well as toxic compounds because they are intermediate bimolecules in various physiological processes and they also cause the oxidative stress. Although there is a balance between the formation and adequate removal of these free radicals in a normal cell, however, this balance get disturbed when there is excessive production of the free radicals or due to insufficient antioxidants in the body [2]. This state of imbalance is called as Oxidative Stress and it can result in serious cell damage if the stress is chronic and massive. In recent years, the free radicals and antioxidant therapy have gained a great attention. The antioxidants are being widely used in the routine general practice. The interest regarding the role of the free radicals in human diseases has increased recently and research implies its potential in the study of further information of oxidative damage dental [3, 4]. The free radicals are the chemically active atoms that have a charge because of having an excess or deficient number of electrons. The free radicals which contain oxygen are known as reactive oxygen species (ROS) and these are the most biologically significant free radicals. Recently, the term "Reactive Oxygen Intermediates" or "Reactive Oxygen Species" is a collective term which has been adopted in order to include molecules like Superoxide anion (O2), Hydroxyl radical (OH), Hydrogen peroxide (H2 O2), Hypochlorous acid (HCIO) [5]. The US Food and Drug Administration (FDA) has defined the antioxidants as "Substances used to preserve food by retarding deterioration, rancidity or discoloration due to oxidation" [6, 7]. Antioxidants can be classified as: Endogenous antioxidants, Dietary antioxidats and Metal binding proteins [8].

Therapeutic Usage of Antioxidants for Oral Lesions-They can prevent the lesions in high risk individuals with clinically normal mucosa with no history of either of either malignant lesions or potentially malignant disorders. They are also beneficial in the treatment of potentially malignant disorders and

also in order to prevent the recurrence of the successfully treated initial lesion or to prevent the development of a second or another primary.

BETA- CAROTENE

It is a fat soluble member of carotenoids and is the most active carotenoid. They are also considered as the provitamin as they can be converted to vitamin A. It is a very strong antioxidant and also one of the best scavengers of singlet oxygen [9]. The color of beta carotene varies from yellow to orange and it is one of the major carotenoids in our diet. It has an important nutritional role as the principal precursor of vitamin [10]. The main function of beta carotene is to act as antioxidant and also the free radical scavenging. Moreover, inhibition of mutagenesis, immunomodulation, and the inhibition of cancer cell growth are also the actions of beta carotene [11].

LYCOPENE

Lycopene is also one of the most potent antioxidant. It is hypothesized to prevent atherogenesis and carcinogenesis by protecting the critical biomolecules like lipoproteins, lipids and DNA [12]. Moreover, lycopene suppresses the carcinogen induced phosphorylation of the regulatory proteins like Rb anti-oncogenes and p53 and stops the cell division as well [13]. The cellular proliferation in various cell lines induced by the potent mitogens like insulin like growth factors is also reduced by lycopene. It exhibits the highest physical quenching rate constant with the singlet oxygen [14, 15]. When it is given in the dosage of 4.8 mg/day per oral for 2-3 months, it leads to the reversal of dysplastic changes in leukoplakia and when it is given in the dosage of 16 mg/day, it may also aid in th substantial increase in the mouth opening in the patients having oral submucous fibrosis. Moreover, multiple studies have explained the reduction in the burning sensation and marked improvement in the mouth opening in OSMF patients when treated with the lycopene treatment than the patients treated with placebo [16]. This curative effect is due to up regulation of lymphocyte resistance to stress and suppression of inflammatory response and by the inhibition of abnormal fibroblasts. Lycopene is also found to be effective in reducing the manifestations of oral lichen planus.

RETINOIDS

These are a class which comprised of natural derivatives as well as the synthetic analogues of Vitamin A [17]. The metabolically active form is Retinol. Now adays, the Retinoids are among one of the best studied micronutrients for the chemoprevention in human. The clinical effects of vitamin A deficiency are related to metaplasia of epithelium [18]. The important derivatives of vitamin A which shows the antimutagenic activities include the 13-cisretinoic acid, 9-cis retinoic acid, all-trans retinoic acid and retinyl palmitate. Among all, 13- cisretinoic acid is most efficient [19].

ASCORBATE

Ascorbate or Vitamin C is mainly found in the citrus fruits. The recent recommended dietary daily allowances for vitamin C are75 mg for women and 90 mg for men. Even the mega doses of vitamin C supplementation i.e., 1-4 g/day are relatively safe [20]. Ascorbic acid is a redox catalyst which can reduce, and therefore neutralizes the reactive oxygen species like hydrogen peroxide. It is also required for the maturation of the procollagen to collagen by oxidizing the proline residues into hydroxyproline and thereby its deficiency results in the disease of gums, skin and other tissues which have high collagen content. The health benefits of vitamin C are anticarcinogenic, antioxidant and immuomodulator [21, 22]. It is also a free radical scavenger and a potent reducing agent in the biological systems.

TOCOPHEROL

Tocopherol or Vitamin E is a fat soluble vitamin which has high antioxidant potency. The recommended daily limit rates are 8 mg/day for adult women and 10 mg/day for adult men. It has been observed that the α-tocopherol form is the most important lipid soluble antioxidant. Moreover, it protects the membranes from getting oxidized by the reaction with the lipid radicals produced in the lipid peroxidation chain reaction [23]. This removes the intermediates free radical and helps in prevention of continuing the propagating reaction. This reaction also produces the oxidised α-tocopheroxyl radicals that can be recycled back to its active and reduced form via reduction by the other antioxidants like ascorbate, retinol etc [24].

POLYPHENOLS/ FLAVONOIDS

The rising interest in the search for the natural replacements of synthetic antioxidants has led to the evaluation of the antioxidant derived from the plant sources [25]. The tea contains catechins which inhibit the production of important metalloproteases, thereby it helps in reducing invasionas well as the migration, induces the apoptosis and arrest the growth arrest in both leukoplakia and the oral cancer [26]. The Methoxylated flavonoids are present in the citrus fruits which prevent the DNA adduct (i.e., a segment of DNA which is bound to a cancer-causing chemical) formation which is usually promoted by the known carcinogens like nitrosamines in tobacco. They also chelate the metal ions and therefore decrease their pro-oxidant activity. Moreover, they inhibit many enzymes responsible for carcinogenesis and tumor development and thereby have an anticancer activity [27].

CURCUMIN

The curcumin is an active ingredient in the dietary spice turmeric and herbal remedy. Many in vitro studies have shown that the curcumin inhibits the cyclo-oxygenase and lipo-oxygenase activities, xanthine oxygenase activities, reactive oxygen species (ROS) generation and nitric oxide production. Moreover, the curcumin also inhibits the production of pro-inflammatory monocyte/macrophagederived cytokines like monocyte chemotactic protein-1 (MCP-1), interleukin-8 (IL-8), tumor necrosis factor-a (TNF-a), interleukin-1b (IL-1b) or alveolar macrophages and peripheral blood monocytes. Curcumin has also shown to reduce the lipid peroxidation and exhibit a potent antioxidant activity. Besides, it also inhibits the cancer development and its progression by targeting multiple steps in the pathogenesis of malignancy. Curcumin has actions both as a blocking agent that inhibits the initial step of the cancer by inhibiting the activation of carcinogen as well as a suppressing agent which inhibits the malignant cell proliferation during the progression of carcinogenesis [28, 29].

CONCLUSION

The overwhelming evidences suggest that the oxidative stress occurs in cells as a consequence of environmental interactions and the normal physiological processes. Moreover, the antioxidant defense systems play a crucial role in the protection against the oxidative damage. The effects of the oxidative stress have been studied extensively in the human body systems and almost in all the known diseases. There should be agreement regarding the optimal dosage for the supplementation of specific antioxidants in specific situations. Till then, the antioxidant supplementation could be promoted by the health fraternity as well as the dental team because the benefits outweigh the risks in several folds.

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