

Analysis of Anti-Oxidant Preparations Available In Indian Market

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Abstract: Objectives: To analyze the various antioxidant preparations available in the Indian market for their formulations, and cost.

Materials and Methods: Anti-oxidant preparations listed in Drug Today India (2014) were analyzed for their formulations, and cost. Preparations containing vitamin A, C, E, Zn, Selenium, along with other multivitamins and minerals are Accepted formulations and not-accepted formulations were identified according to DCGI & CDSCO. Preparations which also contain phytochemicals and other plant products are considered as not-accepted formulations. Prices of accepted formulations were compared with that of not-accepted formulations. Out of 575 formulations, 79(13.7%) were accepted formulations and 496(86.3%) preparations were not-accepted formulations. Cost of accepted formulations is less than that of not-accepted formulations.

It is proven that excess usage of antioxidant preparations with vitamins and minerals is harmful to the health. So DCGI has to encourage people to use more vegetables and fruits which are rich in phytochemicals instead of taking costly antioxidant preparations and has to invite more studies on the beneficial effects of phytochemicals.

Keywords: Anti-oxidant preparations, phytochemicals, accepted formulations, not-accepted formulation.

I. Introduction

Free radical induced oxidative damage is considered as a major risk factor for many diseases and ageing. Free radical is an atom or molecule with one or more unpaired electrons. These are highly unstable, highly reactive and generated in the body constantly during metabolic reactions. Free radicals are also formed during phagocytosis and from toxic environmental pollutants, ionizing radiation, heavy metal poisoning, cigarette smoke, alcohol. Free radicals being highly reactive can oxidized biomolecules leading to tissue injury and cell death¹. These are normally removed by enzymatic and nonenzymatic anti-oxidant defense mechanisms. Deficiency of such mechanisms leads to oxidative damage. To prevent such damage antioxidant preparations are widely used by many people all over the world.

An antioxidant is a molecule that inhibits the oxidation of other molecules. Oxidation is a chemical reaction that transfers electron or hydrogen from a substance to an oxidizing agent. Although oxidation reactions are crucial for life, they can also be damaging. Oxidation reactions can produce free radicals, excess of which damage cell structure and function

II. Oxidative Damage-Diseases

Oxidative stress is defined as a "state in which oxidation exceeds the antioxidant systems in the body secondary to a loss of the balance between them."² An imbalance between oxidants and antioxidants, the two terms of the equation that defines oxidative stress, and the consequent damage to cell molecules constitutes the basic tenet of several pathophysiological states, such as neurodegeneration, cancer, mutagenesis, cardiovascular diseases, and aging.

Oxygen is a relatively unreactive compound that can be metabolized *in vivo* to form highly reactive oxidants known as oxygen free radicals. Increasing evidence suggests that the generation of these oxygen free radicals plays an important role in the pathophysiology of at least three disease states: ischemia reperfusion injury, Phagocyte -dependent inflammatory damage, and neurodegenerative disorders as well as aging.

Other clinical conditions in which the involvement of oxygen free radicals has been suggested are porphyria, cataract, retrolental fibroplasias, macular degeneration, retinopathy, ocular haemorrhage, Parkinson's disease, Alzheimer's disease, Multiple sclerosis, atherosclerosis, myocardial infarction / stroke, adriamycin cardiotoxicity, cardiomyopathy, rheumatoid arthritis, autoimmune diseases, glomerulonephritis, vasculitis, sperm abnormalities, hypertensive complication of pregnancy, congenital malformations, childhood cancers etc^{3,4}

Internally generated sources of free radicals are mitochondria, phagocytes, xanthine oxidase, reactions involving iron and other transition metals, arachidonate pathways, peroxisomes, exercise, inflammation, ischemia/reperfusion.

Externally generated sources of free radicals are cigarette smoke, environmental pollutants, radiation, ultraviolet light, ozone, certain drugs, pesticides, anaesthetics, industrial solvents.⁴

III. Anti-Oxidant System

A. Primary Anti-oxidants: Prevents the formation of new free radical species by converting existing free radicals into harmless molecules before they are able to react or by preventing formation of free radicals from other molecules.

Eg. Super Oxide Dismutase (SOD) converts O_2 to H_2O_2

Glutathione Peroxidase (GPX) converts H_2O_2 to less harmful molecules.

Metal binding proteins, eg. ferritin and ceruloplasmin, limit the availability of Fe for formation of OH radical.

B. Secondary anti-oxidant system: Trap free radicals, preventing chain reactions

Eg. Vitamin A (beta carotene), Vitamin C, Vitamin E, albumin.

C. Tertiary Anti-oxidant system: Repair biomolecules damaged by free radicals.

Eg. DNA repair enzymes, methionine sulfoxide reductase enzymes.

Oxidative damage in DNA can cause cancer. Several antioxidant enzymes such as superoxide dismutase, catalase, glutathione peroxidase, glutathione reductase, glutathione S-transferase etc. protect DNA from oxidative stress.

Antioxidants are classified into two broad divisions, depending on whether they are soluble in water (hydrophilic) or in lipids (lipophilic). In general, water-soluble antioxidants react with oxidants in the cell cytosol and the blood plasma, while lipid-soluble antioxidants protect cell membranes from lipid peroxidation⁷.

Antioxidants And Their Uses

Antioxidant can intervene at any level from the process of free radical generation to tissue injury. They can block the formation of toxic free radicals, block chain reactions induced by free radicals, scavenge free radicals, enhance endogenous antioxidant capability. Thus at low concentrations they can prevent or delay the oxidation of lipids, carbohydrates, proteins and nucleic acids to improve the quality of life by retarding the aging process.

IV. Antioxidant Vitamins

Vitamin A: Beta carotenoids are precursor of Vitamin A, serve as anti-oxidants, reduce the risk of epithelial cancer due to free radical damage. It has also been shown to provide protection from MI and photo sensitization¹. Beta carotene is less effective than alpha tocopherol. Beta carotenes are found in vegetables like carrots, papaya, mangoes, pumpkins, green leafy vegetables. Excess intake can lead to toxicity. Recommended Daily allowance is for children 400-600 μ g/day, for adults 750-1000 μ g/day. Normal blood levels of vitamin A is 25-50 μ g/dl.³

Vitamin C: Ascorbic acid reacts with H_2O_2 , peroxide and super oxide free radicals, and gets oxidized to dehydro ascorbate. Dehydroascorbate is reduced back to ascorbic acid by glutathione reductase. Deficiency of vitamin C predisposes to atherosclerosis, and carcinogenicity. It also inhibits nitrosamine formation due to tobacco use¹. Diet sources are amla (700mg/100g), guava (300mg/100g), and citrus fruits. RDA is 75mg/day (equal to 50ml of orange juice)

Vitamin E: Vitamin E is the most powerful natural antioxidant, and the collective name for a set of eight related tocopherols and tocotrienols, which are fat-soluble vitamins with antioxidant properties^{8,9}. α -tocopherol form is the most important lipid-soluble antioxidant, and that it protects membranes from oxidation by reacting with lipid radicals produced in the lipid peroxidation reaction^{8,10}. This removes the free radical intermediates and prevents the propagation reaction. It provides protection against neurological damage, atherosclerosis, thrombotic vascular disease, and retrolental fibroplasia¹. Caution should be kept in using Vitamin E. Excess quantity of Vitamin E may act as Pro-oxidant and may be deleterious. It can depress leukocyte oxidative bactericidal activity. Recommended daily allowance 8 -10 mg/day³ Pharmacological dose 200-400IU/day

V. Antioxidant Minerals

These chemical elements have no antioxidant action themselves and are instead required for the activity of some antioxidant enzymes.

Selenium is a trace element which enhances the antioxidant activity of vitamin E. It also promotes synthesis of glutathione peroxidase, as well as stimulates the immune system of the body.

Manganese, Zn, Copper, and Chromium are good sources for generating superoxide dismutase, glutathione peroxidase and catalase enzyme.

VI. Phytochemicals

Phytochemicals are garlic, grape fruit juice, soya bean, turmeric, tomato, and herbal preparations containing bioflavonoids also have good antioxidant properties. These are considered much safer in day to day use and are claimed to reduce the risk of atherosclerosis, Myocardial Infarction, and various cancers.

Spirulina, a blue green algae from shallow pond water, having excellent antioxidant properties, it is a good source for superoxide dismutase, beta carotene, and B-complex vitamins; It is used as single preparation or in combination with other vitamins and minerals.

People who eat fruits and vegetables appear to have a lower risk of heart disease, some neurological diseases¹¹, and some cancers¹². Since fruits and vegetables happen to be good sources of nutrients and phytochemicals. This suggested that antioxidant compounds might lower the risk against several diseases.

VII. Materials And Methods

Anti-oxidant preparations listed in Drug Today India (2014)¹³ were analyzed for their formulations, and cost. Preparations containing vitamin A, C, E, Zn, Selenium, along with other multivitamins and minerals are Accepted formulations and irrational formulations were identified according to DCGI & CDSCO. Preparations which also contain phytochemicals and other plant products are considered as irrational formulations. Prices of accepted formulations were compared with that of irrational formulations.

Out of 575 formulations, 79(13.7%) were accepted formulations and 496(86.3%) preparations were irrational formulations. Cost of accepted formulations is less than that of irrational formulations.

VIII. Discussion

Antioxidants have been investigated as possible treatments for neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease, and Amyotrophic lateral sclerosis^{14,15}, and as a way to prevent atherosclerosis¹⁶. In general these trials have shown equivocal effects on patient outcomes.^{17,18,19}

Although some levels of antioxidant vitamins in the diet are required for good health, there is considerable doubt as to whether antioxidant supplements are beneficial or harmful; and if they are actually beneficial, which antioxidant(s) are needed and in what amounts.^{11,20,21}. Indeed, some authors argue that the hypothesis that antioxidants could prevent chronic diseases has now been disproved and that the idea was misguided from the beginning.²² Rather, flavonoids and other phytochemicals have antioxidant roles in minute concentrations that affect cell-to-cell signaling, receptor sensitivity, inflammatory enzyme activity or gene regulation^{23,24}.

IX. Conclusion

DCGI is accepting antioxidants with vitamins and minerals .but so many antioxidants with phytochemicals are available in market at higher cost. It is proven that excess usage of antioxidant preparations with vitamins and minerals is harmful to the health. So, It is better to encourage people to use more vegetables and fruits which are rich in phytochemicals instead of taking costly antioxidant preparations. More studies are needed on the beneficial effects of phytochemicals.

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