

Conceptual Editorial

Status of Non-Communicable Diseases and Their Prevention through the Use of Antioxidants

A disease is any abnormal condition that causes a disruption in the functions of a body tissue, organ, or entire organism and toxicity is the intrinsic capacity of a chemical agent to affect an organism adversely. The diseases are recognized by a specific set of symptoms. There are two types of diseases.

1. Communicable diseases (CDs)

Communicable diseases like Cholera, Salmonellosis, Shigellosis, Swine flu, Influenza, Covid-19, Jaundice etc. are spread from soil, air, water, food and person-to-person or from animal to person. The spread or transfer can also happen through contact with contaminated surfaces, or through direct contact with blood, feces, or other bodily fluids.

2. Non-communicable diseases (NCDs)

India like most of the rapidly growing economies is facing a looming epidemic of Non-Communicable Diseases (NCDs) because market forces promote junk foods, food additives, tobacco, alcohol and also because of pesticide residues, contaminants, air pollution etc. Random genetic abnormalities, heredity, food contaminants, lifestyle or environment can cause NCDs, such as cancer, diabetes, asthma, hypertension and osteoporosis, autoimmune diseases, trauma, fractures, mental disorders, malnutrition, poisoning and hormonal conditions.

NCDs are the diseases which are not contagious or transferable from one person to another. Nearly 61% of deaths in India are now attributed to NCDs, including heart disorders, cancer and diabetes, according to the data released by the WHO. Global Survey 2015 (WHO), states that NCDs kills 41 million people each year, equivalent to 71% of all the deaths globally and these contribute to around 5.87 million (60%) of all deaths in India. Each year 16 million people die prematurely - before the age of 70 - from heart and lung diseases, stroke, cancer and diabetes. Cardiovascular diseases (coronary heart disease, stroke, and hypertension) contribute to 45% of all NCD deaths, followed by chronic respiratory disease (22 %), cancer (12 %) and diabetes (3%). Cancer, diabetes and heart diseases alone account for 55% of the premature mortality in India in the age group of 30-69 years (2016). Cancer is one of the leading cause of death in India with 28 lacs cases at a point of time and 10 lacs new cases taking place very year. Diabetes accounts for 1.09 lakh deaths in a year.

Worldwide, the burdens of chronic diseases like cardiovascular diseases, cancers, diabetes and obesity is rapidly increasing. It has become increasingly evident that free radicals play a major role in a variety of normal regulatory systems in humans, the deregulation of which may lead to multifarious disturbances. Free radicals have been reported to be involved in a number of clinical diseased states.



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Free radicals are oxygen containing molecule that has one or more unpaired electrons, making it highly reactive species with other molecules. The chemical reactivity of the free radicals is usually high. Radicals can have positive, negative charge or neutral. Free radicals are waste substances produced by the cells as the body processes food and reacts to the environment. They are formed as necessary intermediates in a variety of normal biochemical reactions, but when generated in excess or not appropriately controlled, radicals can wreak havoc on a broad range of macromolecules. The free radicals can chemically interact with cell components such as DNA, protein or lipid and steal their electrons in order to become stabilized. This, in turn, destabilizes the cell component molecules which then, seek and steal an electron from another molecule, therefore, triggering a large chain of free radical reactions. Every cell that utilizes enzymes and oxygen to perform functions is exposed to oxygen free radical reactions that have the potential to cause serious damage to the cell. The free radicals, both the reactive oxygen species (ROS) and reactive nitrogen species (RNS), are derived from both endogenous sources (mitochondria, peroxisomes, endoplasmic reticulum, phagocytic cells etc.) where the oxygen consumption is high and exogenous sources (pollution, alcohol, tobacco smoke, heavy metals, transition metals, industrial solvents, and pesticides, ultraviolet light, cooking (smoked meat, used oil, fat), certain drugs like halothane, paracetamol, and radiation). Free radicals like peroxides, superoxide, hydroxyl radical, singlet oxygen etc. can adversely affect various important classes of biological molecules thereby, altering the normal redox status leading to increased oxidative stress. Excess of these causes oxidative stress which is essentially an imbalance between the production of free radicals and the ability of the body to counteract or detoxify their harmful effects through neutralization by antioxidants. If the body cannot process and remove free radicals efficiently, oxidative stress can result.

Oxidative Stress — a common denominator in pathogenesis of NCDs is defined as ‘prooxidant-antioxidant imbalance’ in favour of the former, leading to potential biomolecular damage afflicted by free radicals RONS (Reactive Oxygen and Nitrogen Species) and disruption of redox signaling and control. Few examples of Reactive Oxygen Species are $O_2^{\cdot-}$, H_2O_2 , OH^{\cdot} , RO^{\cdot} , ROO^{\cdot} and Reactive Nitrogen Species are NO^{\cdot} , NO , $ONOO^-$. Operational concepts in the definition entail prooxidant-antioxidant imbalance which decodes that RONS, at low and steady concentrations exquisitely controlled by body antioxidants, are cardinal for normal physiological functioning i.e. immunity, muscular contraction, nerve transmission, gene expression, reproduction, apoptosis and so forth, and that oxidative stress results due to high, toxic levels of RONS supplied either by environmental stressors or emasculated antioxidant systems. Numerous epidemiological studies have demonstrated the association between oxidative stress and NCDs.

Oxidative stress leads to many pathophysiological conditions in the body which include neurodegenerative diseases such as Parkinson’s disease and Alzheimer’s disease, Gene mutations and Cancers, Chronic fatigue syndrome, Fragile X syndrome, Heart and blood vessel disorders, atherosclerosis, heart failure, heart attack and Inflammatory diseases. Oxidative stress has been implicated to play a prudent role in the pathology of 120 diseases, with robust in vivo (rats and humans) evidences for cancer, neurodegenerative, cardiovascular, autoimmune, inflammatory diseases.

Antioxidants are substances that can prevent or slow damage to cells caused by free radicals, unstable molecules that the body produces as a reaction to environmental and other pressures. These are molecules present in cells that prevent these reactions by donating an electron to the free radicals without becoming destabilized themselves. An imbalance between oxidants and antioxidants is the underlying basis of oxidative stress. Antioxidants act as radical scavenger, hydrogen donor, electron donor, peroxide decomposer, singlet oxygen

quencher, enzyme inhibitor, synergist, and metal-chelating agents. Examples of antioxidants are Vitamin A/ beta-carotene, vitamin C, vitamin E, lycopene, Lutein, selenium, manganese, zeaxanthin, flavonoids, flavones, catechins, polyphenols, and phytoestrogens. Over the last years, exogenous antioxidants have received great attention because of their potential beneficial effects toward human health. Contained in foods commonly consumed in all populations worldwide, antioxidants represent an attractive explanation of their beneficial effects in prevention of NCDs.

Significance of dietary antioxidants

In the 21st century, people need to get more antioxidants, popularly extolled as 'life span essentials' in the diet to offset the oxidative assaults laid on too thick by deplorably polluted environment, refined and convenient approaches to modern lifestyle, and also the rampant burden of NCDs. It has been estimated that a healthy diet can prevent approximately 30% of all cancers. Various epidemiological investigations and intervention trials have purported dietary/native antioxidants (present in nutritional doses), instead of supplemental antioxidants, to be effective candidates against chronic health complications.

Phytochemicals are gaining unprecedented recognition, apparent from their citation as 'foods for the 21st century'. They are non-nutritive, bio-active plant chemicals in fruits, vegetables, grains with health benefits; and broadly categorised as carotenoids, phenolics, alkaloids, nitrogen-containing and organosulfur compounds. Polyphenols, forming the largest class of phytochemicals and popularly cited as life span essentials, are gaining robust interest attributed to their potent antioxidant activity, ubiquitous presence in plant foods and documented literature corroborating their health-promoting and disease-preventing potential.

Looking into the above facts it is clear that there is great scope in exploitation of untapped sources of antioxidant rich foods like Flax seed, Cress seeds, minor millets, fruits and vegetables specially unexploited wild vegetables like *Amaranthus blitumvaroleracea*, *Chenopodium album*, *Amaranthus spinosus* L etc. and many hundreds from all corners of rural India and the traditional foods used by our ancients. So, I am of the opinion that future research should be focused in exploitation and development of nutraceutical/antioxidant rich foods to prevent the ever growing status of non-communicable diseases.

Hippocrates, the great physician of ancient Greece (460 BC-370 BC) argued and concluded that disease was not a punishment inflicted by the gods, but largely the product of environmental factors, genetics, and/or bad diet and unwise or unfortunate living habits and conditions. Considered a father of Western medicine, Hippocrates advocated the healing effects of food. "*Let Food be thy Medicine*" The Philosophy behind is: "*Focus on Prevention*".

The antioxidants market: The Asia-Pacific region accounted for the largest market share in the food antioxidants market in 2015 on account of changing lifestyle of consumers, increasing health problems, rising disposable income, and growing demand for anti-aging products.. The major countries contributing significantly toward the growth of the market include China, India, Japan, Australia, and New Zealand. The Global Food Antioxidants Market is expected to reach USD 1.73 billion by 2025, from USD 1.16 billion in 2017 growing at a CAGR of 6.1% during the forecast period of 2018 to 2025.

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