Health Benefits of Antioxidants and Phytochemicals

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"Let food be thy medicine; and medicine be thy food" Hippocrates (431 BC)

Food intake – both in terms of quantity and quality influence the nutrition/health status as well as overall wellbeing of the individuals. Therefore, for maintaining physical and mental health, adequate amounts of all essential nutrients must be included in our diet right from infancy until old age. The phrase 'we are what we eat' aptly signifies that our body composition largely depends on our diet. No single food is able to meet all our nutritional needs. Our diet should be nutritionally well balanced and it should be able to provide adequate amounts of energy, protein, fats, carbohydrates, vitamins, minerals, dietary fibre and water.

Nutrition plays an important role in our health and well-being. Apart from the already known dietary constituents; in the recent years, there has been an increasing interest in certain compounds having enormous health effects which include **antioxidants** and **phytochemicals**.

An **antioxidant** is a molecule that inhibits the oxidation of other molecules. Although oxidation reactions are crucial for life, many times these can be damaging too. The free radicals produced during oxidative processes release highly-reactive compounds generated in the body as by-products of normal processes or these may enter the body from the environment. Insufficient levels of antioxidants or inhibition of the antioxidant enzymes cause oxidative stress that may damage or kill the DNA cells. Anti-oxidants are the compounds that inactivate the oxygen species/free radicals and, thus, prevent the oxidative damage to the cells and body tissues. Plant foods confer numerous health benefits as they combat oxidative stress in the body by maintaining a balance between oxidants and antioxidants. Plant/animal foods contain a variety of nutrient/non-nutrient antioxidants, such as glutathione, vitamin C, vitamin A, and vitamin E. Antioxidants are widely being used as dietary supplements and have been investigated for the prevention of diseases such as cancer, coronary heart disease and even altitude sickness.

Phytochemicals, on the other hand, are the compounds that occur naturally in plants (in Greek, phytomeans 'plant'). Technically, though it refers to a wide variety of plant based compounds, the term is mainly used for the compounds that may affect human health.

The term phytochemicals refers to a variety of non-nutritional biologically active compounds (flavonoids and polyphenols) occurring in plant foods that confer various health benefits beyond basic nutrition.

Phytochemicals are virtually present in all the fruits, vegetables, pulses/legumes and grains which are commonly consumed, so it is quite easy to incorporate them in our daily diet. Although thousands of phytochemicals have been identified, only a small fraction of them have been studied closely. Some of the better-known phytochemicals include β-carotene and other carotenoids, ascorbic acid (vitamin C), folic acid, and vitamin E. Some phytochemicals may possess antioxidant activity or hormone-like actions too.

Potential health benefits of antioxidants

- Antioxidants counteract the damaging effects of oxidation in our body. These include vitamin A, ascorbic acid (vitamin C), vitamin E, polyphenols and certain minerals (like selenium) that boost our immune function by quenching the free radicals.

The free radicals are highly-reactive compounds that are formed as by-products during normal metabolic processes occurring in the body or these may enter the body from the environment. By neutralizing these harmful compounds, antioxidants help in preventing various forms of cancer as well as in the management of HIV patients by boosting their immune system.

- Antioxidants such as vitamin E and ascorbic acid may help in delaying the process of aging; and these may even prevent or reverse the memory loss.

Studies indicate that certain combinations of antioxidant-rich foods exert potential health benefits not accorded by the individual foods. For instance, the combination of antioxidants present in blueberry, strawberry and spinach protect the nervous system by inhibiting the enzyme that may be involved in certain neurological disorders including autism, depression and schizophrenia.

- Antioxidants are possibly beneficial in the treatment of certain neurodegenerative diseases like Alzheimer's disease (AD)/Parkinson's disease (PD).

Alzheimer's Disease (AD) is a chronic progressive form of dementia characterised by the accumulation of plaques in certain regions of the brain as well as the degeneration of certain types of neurons. It usually begins after the age of 70 years. Initial symptoms include forgetfulness and reduced sensitivity to smell/taste gradually leading to behavioural problems such as wandering, aggression and sleep disorders. These affect the food intake and drain out the nutrient reserves leading to nutritional deficiencies.

Parkinson's Disease (PD) is characterised by an inadequate production of dopamine. PD usually begins around 60 years of age or earlier. It is more common in men than in women. Salient symptoms include trembling of hands, arms, legs, jaw and face; stiffness of arms, legs and trunk; slowness of movement; and lack of balance/coordination. Some patients may also experience depression and sleep problems.

Due to beneficial interactions between antioxidants and other food components, it is advisable to obtain antioxidants from food sources as these may confer better health benefits than those taken in the form of supplements.

The current lifestyle related changes (sedentary lifestyle, faulty dietary practices, stress and in some cases smoking/drug abuse/alcohol consumption) may cause over-production of free radicals and reactive oxygen species. A number of natural antioxidants not only reduce oxidative stress, but also provide protection against various degenerative diseases; and thus, antioxidants play a significant role in health care. Plant foods are the primary sources of naturally occurring antioxidants; fruits, vegetables, roots and tubers being the rich sources of polyphenols. Hence, an increased consumption of fruits/vegetables is advocated for lowering the risk of various degenerative diseases. Natural antioxidants, because of safety and potential therapeutic effects, have gained considerable interest of the nutritionists, food manufacturers and consumers.

Based on potent antioxidant activity of the phenolic compounds, the total phenolic content (TPC) of plant foods varies considerably. The TPC of fresh fruits ranges from 26 mg/100g (watermelon) to 374 mg/100g (guava) and that of the dry fruits from 99.0 mg/100g (piyal seeds/chirongi nuts) to 959.7 mg/100g (walnuts). Further, intensely coloured vegetables like beetroot and red cabbage have high antioxidant activity while carrots have the lowest TPC.

It is important to remember that high-doses of antioxidant supplements may, in some cases, cause health risks. For example, high doses of β-carotene may increase the risk of lung cancer among the smokers while that of vitamin E may increase the risk of prostate cancer and stroke.

Food items, termed as functional foods, are designed to facilitate the consumption of enriched foods in their natural state, rather than the dietary supplements in the liquid or capsule form. The functional foods are enriched or fortified to restore the nutrients to levels equal to or more than that present in the food prior to processing. Sometimes complementary nutrients/certain compounds are also added to improve nutritional value or health effects of the food such as addition of vitamin D in milk, plant sterols to milk based drinks.

Phytochemicals and their health effects

Intake of phytochemicals (polyphenols, tocopherols, tocotrienols, carotenoids, and ascorbic acid) has been associated with the maintenance of good health as well as prevention/treatment of many health conditions including cancer, cardiovascular diseases, diabetes, hypertension, stroke, metabolic syndrome and other degenerative diseases.

Certain phytochemicals are responsible for the colour and other organoleptic properties of the foods, such as the deep purple colour of blueberries and the peculiar odour of garlic. There may be as many as 4,000 different phytochemicals having potential benefits in diseased conditions; lycopene present in tomatoes has been tested for providing protection against cardiovascular diseases and prostate cancer.

Among several major groups of phytochemicals, polyphenols include a large subgroup of compounds known as flavonoids. Flavonoids are present in a wide range of fruits, vegetables and grains; isoflavones (present in soybean/soy products; lignans in flaxseeds - alsi seeds and whole grains) mimic the action of female hormone - estrogen. These seemingly estrogen-like substances from plant sources called phytoestrogens may play an important role in providing protection against some hormone-dependent cancers like certain types of breast/prostate cancer.

Other polyphenols (including certain flavonoids) act as antioxidants. These compounds are commonly found in tea and vegetables such as broccoli, brussels sprouts, cabbage, and cauliflower. Black grapes, red cabbage and red-radish contain anthocyanidins (a type of flavonoid) that act as potent antioxidants. Carotenoids, which impart yellow to orange colour to vegetables and fruits are promoted as anti-cancer agents. Tomatoes, red pepper, and pink grapefruit contain lycopene which again is a powerful antioxidant; lutein and zeaxanthin are carotenoids present in green leafy vegetables reduce the risk of certain cancers. Another group of phytochemicals, called allyl sulfides (present in garlic and onion) may stimulate enzymes that help the body to get rid of harmful chemicals. These may also help in strengthening the immune system.

To derive the maximum health benefits, we need to ensure the consumption of sufficient quantities of natural antioxidants and phytochemicals from a variety of plant sources.

(Source: PIB)