



Antioxidants: Essential for better health

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Abstract

Antioxidants are the defense system of the body against the damage of reactive oxygen species which physiological processes in the body^{1, 2}. There are various sources of these antioxidants like endogenous antioxidants present in the body and exogenous in food source. Some biological properties such as anti-carcinogenicity, anti-mutagenicity, anti-allergenicity and antiaging activity have been reported for natural and synthetic antioxidants³. Among the sources of natural antioxidants, the most important are those coming from routinely consuming vegetables and fruits^{4, 5}, however, antioxidants from other plants and agriculture waste should not be ignored. Natural oxidants are widely distributed in food and medicinal plants. The present paper provides comprehensive basic information about antioxidants, how do antioxidants work, types of antioxidants and their main resources from food and their main resources from and medicinal plants.

Keywords: antioxidants, better health

Introduction

The formations of oxygen reactive forms as a result of rigorous oxidative processes taking place in human organism are the potent precursors of systemic cells and tissues damage. Normally, antioxidants system occurring in human body can scavenge these radicals, which would keep the balance between oxidation and anti-oxidation^[6, 7]. Nonetheless, the exposure of cigarette smoking, alcohol, radiation or environmental toxins induces the production of excessive reactive oxygen species (ROS) and reactive nitrogen species (RNS). Which disrupt the balance between oxidation and anti-oxidation and result in some chronic and degenerative diseases^[8]. Intake of exogenous antioxidants would ameliorate the damage caused by oxidative stress^[9, 10]. The exogenous antioxidants are mainly derived from food and medicinal plants, such as fruits, vegetables, cereals, mushrooms^[11, 12], beverage, flowers, spices and traditional medicinal herbs. Generally, these natural antioxidants, especially polyphenols^[13-15] and carotenoids, exhibits a wide range of biological effects, such as anti-inflammatory, antibacterial, antiviral, anti-aging and anticancer^[16-18].

Natural antioxidants are primarily phenolics that may occur in all parts of plants, such as fruits, vegetables, nuts, seeds, leaves, roots and barks^[19-22]. The antioxidants from the nature can be categorized into the various subclassifications. However, two major categories are like antioxidants from commonly consumed or routine natural diets (e.g. vegetables, fruits, cereals, and beans) and secondly from plants or herbs source that have fair antioxidants potential. The people who are habitual of consuming these vegetables and fruits in their routine meal are reported to be less affected by various chronic disease and studies have also endorsed the long term healthy impact of consuming these nature origin diets.

The main objective of the current paper is to overview and summarize the natural sources with antioxidants potential. The summarized data will be a useful information for the lay man to understand about antioxidants, role in boosting

health and their food resources.

What is Antioxidant: Antioxidants are substances that can prevent or slow damage to cells caused by oxidation. Oxidation is a chemical reaction that can produce free radicals, thereby leading to chain reactions that may damage the cells of organisms. Antioxidants such as thiols or ascorbic acid terminate these chain reactions.

They are also called “free radical scavengers”. Antioxidants are said to help neutralize free radicals in our bodies and this is thought to boost overall health.

The body also produces some antioxidants known as endogenous antioxidants. Antioxidants that come from outside the body are called exogenous.

Free radicals: Free radicals are waste substances produced by cells as the body processes food and reacts to the environment^[23]. If the body cannot process and remove free radicals efficiently oxidative stress can result. This can harm cells and body function. Free radicals are also known as reactive oxygen species (ROS).

Factors that increase the production of free radicals in the body can be internal such as inflammation or external for example pollution, UV exposure and cigarette smoke^[24].

The Effect of Free Radicals

Some conditions caused by free radicals include^[25].

- Deterioration of the eye lens (vision loss)
- Inflammation of the joints (Arthritis)
- Damage to nerve cells in the brain (Alzheimer's)
- Acceleration of the ageing process
- Increased risk of coronary heart diseases
- Certain cancers

Types of Antioxidants: There are thought to be hundreds and possibly thousands of substances that can act as antioxidants. Each has its own role and can interact with other to help the body work effectively.

Flavonoids, flavones, catechins, polyphenols, and

phytoestrogens are all types of antioxidants and phytonutrients, they are all found in plant based foods [26]. Each antioxidant serves a different function and is not interchangeable with another.

Antioxidants can be divided into three groups by their mechanism

- 1. Primary Antioxidants:** Which function essentially as free radical terminators (scavengers).
- 2. Secondary Antioxidants:** Which are important preventive antioxidants that function by retarding chain initiation.
- 3. Tertiary Antioxidants:** They act by repairing the oxidized molecules through sources like dietary or consecutive antioxidants.

Examples of antioxidants that come from outside the body include

- Vitamin A
- Vitamin A
- Vitamin C
- Vitamin E
- Beta-Carotene
- Lycopene
- Lutein
- Selenium
- Manganese
- Zeaxanthin

Benefits of Antioxidants: Antioxidants are compounds produced in our body and found in foods. They help defend our cells from damage caused by potentially harmful molecules known as free radicals. When free radicals accumulate, they may cause a state known as oxidative stress. Our body's cells face threats every day. Viruses and infections attack them. Free radicals also can damage our cells and DNA. Some cells can heal from the damage while others cannot. Antioxidants help stop or limit damage caused by free radicals. Our body uses antioxidants to balance free radicals. This keeps them from causing damage to other cells. Antioxidants can protect and reverse some of the damage. They also boost our immunity.

Path to improved health

Free radicals are natural or man-made elements. They can be-

- Chemicals our body produced by turning food into energy.
- Environmental toxins, like tobacco, alcohol and pollution.
- UV Rays from the sun or tanning beds.
- Substances found in processed food.

Antioxidants can help fight and reduce free radicals and the damage they cause our body produces some antioxidants is through certain foods and Vitamins. Each antioxidant has a different chemical makeup. Each one provides different health benefits. Too much of one antioxidant can be harmful. Antioxidants help protect human body cells from the formation of radicals. They comprise Vitamins, Minerals, Enzymes and natural products. Radicals also known as free radicals are molecule with one unpaired electron or two or more unpaired electrons that do not

Interact with one another. Oxygen derived free radicals are aggressive and toxic and are produced typically during cell metabolism.

They are common transient intermediaries in chemical reaction with cell components, causing permanent damage. They are believed to be the source of aging and the cause of a number of degenerative diseases.

In the human body, white blood cells (WBC) interact with the free radicals protecting body cells from harm. Exposure to environmental perils, such as smoking, pollution, such radiation or other toxins increases oxidative stress beyond a levels at which the immune system can mount a defense with increases in free radicals in the human body, the immune systems resources will be heavily involved in fighting free radicals. The ability of antioxidants to combat free radicals strengthens the immune system to identify and fight toxins.

There are three known free radicals

1. Superoxide
2. Hydroxyl
3. Peroxide

Antioxidants attach to the free radicals and form a complex that prevents cell destruction and is easily cleaned out as waste by the human body. The result is less cell damage and a healthier immune system, among other benefits.

This article reviews the major sources and roles of several antioxidants in the protection of human body cells to promote health and well-being.

Sources of Antioxidants

Plant foods are rich sources of antioxidants. They are most abundant in fruits and vegetables, as well as other foods including nuts, wholegrains and some meats, poultry and fish.

Table 1

Antioxidants	Source
Allium sulphur compound	Leeks, onions, garlic
Anthocyanins	Eggplant, grapes, berries
Beta-carotene	Pumpkin, mangoes, apicots, carrots, spinach, parsley
Catechins copper	Red wine, tea, seafood, lean meat, milk, nuts
Cryptoxanthins	Red capsicum, pumpkin, mangoes
Flavonoids	Tea, green tea, citrus fruits, red wine, onion, apples
Indoles	Cruciferous vegetables such as broccoli, cabbage and cauliflower
Isoflavonoids	Soybeans, tofu, lentils, peas, milk
Ligans	Sesame seeds, bran, whole grain, vegetables
Lutein	Green, leafy vegetables like spinach, corn
Lycopene	Tomatoes, pink grapefruit, watermelon
Manganese	Seafood, lean meat, milk, nuts
Polyphenols	Thyme, oregano
Selenium	Seafood, offal, lean, meat, whole grain
Vitamin A	Liver sweet potatoes, carrots, milk, egg yolks
Vitamin C	Oranges, black currants, kiwifruits, mangoes, broccoli, spinach, capsicum, strawberries
Vitamin E	Vegetable oils, avocados, nuts seeds and whole grains
Zinc	Seafood, lean meat, milk, nuts
Zoo chemicals	Red meat, offal and fish

Antioxidants isolated from herbal spices

Table 2

Spices	Antioxidants
Rosemary	Carnosic acid, Carnosol, Rosemarinic acid, Rosmanol
Sage	Carnosol, Carnosic acid, Rosmanol, Rosmarinic acid
Oregano	Derivatives of phenolic acid
Thyme	Carvacrol, thymol, p-cymene, Caryophyllene, Carvotanacetone, Borneol
Summer Savory	Rosmarinic acid, Carnosol, Carvacrol
Savory	Thymol
Marjoram	Flavonoids
Allspice	Pimentol
Black pepper	Phenolic amides, Flavonoids
Ginger	Gingerol
Turmeric	Curcumin

Antioxidants are compounds produced in our body and found in foods. Eating a diet rich in antioxidants can help increase our blood antioxidant levels to fight oxidative stress and reduce the risk of these diseases^{27,28}.

Here are the top 12 healthy foods that are high in antioxidants-

1. Dark Chocolate: Dark chocolate is nutritious. It has more cocoa than regular chocolate as well as more minerals and antioxidants. Based on the FRAPC (Ferric Reducing Ability of Plasma), dark chocolate has up to 15 mmol of antioxidants per 100 grams. This is even more than blueberries and raspberries. Dark chocolate may reduce the risk of heart disease by raising blood antioxidant levels raising levels of “good” HDL cholesterol and preventing “bad” LDL cholesterol from becoming oxidized. LDL cholesterol promotes inflammation in the blood vessels, which can lead to an increased risk of heart disease.



Fig 1

2. Pecans: Pecans are popular nuts rich in minerals, healthy fats and antioxidants. They may also help raise blood antioxidant levels and lower bad cholesterol.



Fig 2

3. Blueberries: Blueberries are packed with nutrients and antioxidants. Blueberries contain the highest amount of antioxidants among all commonly consumed fruits and vegetables. They are rich in anthocyanins and other antioxidants that may help reduce the risk of heart disease and delay the decline in brain function that happens with age.



Fig 3

4. Strawberries: Like other berries, strawberries are rich in antioxidants called anthocyanins, which may help reduce the risk of heart disease. They are sweet, versatile, and a rich source of Vitamin C and antioxidants.



Fig 4

5. Artichokes: Artichokes are vegetables with dietary fiber, minerals, some of the highest levels of antioxidant, including chlorogenic acid. The antioxidant and anti-inflammatory benefits of chlorogenic acid may reduce the risk of certain cancers, type 2 diabetes and heart disease²⁹. The antioxidant content of artichokes can vary, depending on how they are prepared.

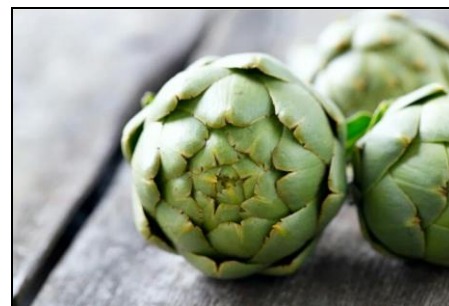


Fig 5

6. Goji Berries: Goji berries are a rich source of antioxidants, including a unique type known as lycium barbarum polysaccharides. These have been linked to a reduced risk of heart disease and cancer and may help fight skin aging.



Fig 6

7. **Raspberries:** Raspberries are nutritious delicious and packed with antioxidants. Like blueberries, they are rich in anthocyanins and have anti-inflammatory effects in the body.



Fig 7

8. **Kale:** Kale is a cruciferous vegetable and a member of the group of vegetables cultivated from the species BRASSICA OLERACEA. Kale is one of the most nutritious green and is rich in Vitamins A, K and C. It's also rich in antioxidants, an important mineral that helps maintain bone health and plays roles in other cellular functions.



Fig 8

9. **Red Cabbage:** It is rich in Vitamins C, K and A and has a high antioxidant content. Red cabbage is a rich source of Vitamin C, which acts as an antioxidant in the body. Vitamin C may help strengthen the immune system and keep the skin.



Fig 9

10. **Beans:** Beans are high in fiber and antioxidant called Kaempferol. This antioxidant has been linked to impressive health benefits, such as reduced chronic inflammation and suppressed cancer growth in the breast, bladder, kidneys and lungs.



Fig 10

11. **Beets:** Beets have a mild taste and are a great source of fiber, potassium, iron folate and antioxidants called betalains that have been linked to impressive health benefits.



Fig 11

12. **Spinach:** Spinach is one of the most nutritionally dense vegetables. It's loaded with Vitamins, minerals and antioxidants (lutein and zeaxanthin) that may help protect our eyes from damaging UV light and other harmful light wavelengths [30].



Fig 12

13. **Purple, Red and Blue Grapes:** Grapes, especially dark coloured ones, and loaded with phytochemicals, antioxidants that may help protect against cancer and heart disease. Grapes also contain Vitamin C and selenium.



Fig 13

14. Nuts: Each type of nut offer a unique profile of minerals, phytochemicals and types of fat. Walnuts are the highest in plant omega-3s, most nuts also contain phytochemicals such as resveratrol and plant sterols, which help lower cholesterol.



Fig 14

15. Dark Green Veggies: These veggies are brimming with antioxidant phytochemicals such as kaempferol which may help dilate blood vessels and may have cancer fighting properties.



Fig 15

16. Sweet Potatoes and Orange Vegetables: Both provide important nutrients such as Vitamins C and B6, potassium and fiber and packed with phytochemicals as well.

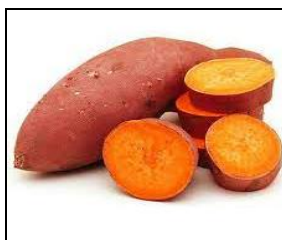


Fig 16

17. TEA: One sip of tea offers phytochemicals anthocyanin and proanthocyanin. Both are antioxidants that help fight inflammation. Green tea is especially abundant with catechin epigallocatechin gallate (EGCG) antioxidant.



Fig 17

18. Whole Grain: Whole grains deliver zinc and selenium, in addition to phytochemicals thought to help protect against heart disease and cancer.



Fig 18

19. Fish: Fish provides powerful omega-3 fatty acids may help prevent inflammatory diseases, such as coronary heart disease. Fish also offers an essential nutrient that's hard to find in food Vitamin D.



Fig 19

20. Coffee: Coffee beans contain disease ravvanging antioxidants, called quinines, which become more potent after roasting. This type of antioxidant along with the magnesium found naturally in coffee, affect blood sugar levels and are thought to be responsible for the link to a lower risk of type 2 diabetes. The lighter roast coffee offer higher antioxidant properties for the drinkers.



Fig 20

Summary: There are many common foods that people can eat to increase the numbers of antioxidants that they consume. The antioxidants in these foods may help promote heart and eye health, prevent cancer and protect against other common diseases that scientists associate with harmful free radicals.

However, researchers still need to understand the extent to which each of these foods helps people acquire higher levels of antioxidants. They also need to determine how effective each is in disease prevention.

Antioxidants are compounds that your body makes naturally, you can get them from foods. They help defend your cells from damage caused by potentially harmful

molecules known as free radicals. When free radicals accumulate, they may cause a state known as oxidative stress. This may damage your DNA and other important structures in your cells.

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