

MEDICINAL PLANTS AS NATURAL ANTIOXIDANTS

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ABSTRACT

Ayurvedic medicines are usually customized to an individual constitution. Ayurvedic Indian and traditional Chinese systems are living 'great traditions' and have important roles in bio prospecting of new medicines from medicinal plants, which are also rich sources of antioxidants. Antioxidants are the substances that may protect cells from the damage caused by free radicals. Since plants generate a great deal of antioxidants that can signify a vital source of fresh compounds with promising antioxidant property. The compounds that are found naturally in the body and also in variety of foods and that can react with and quench or inactivate a free radical so it cannot cause cellular damage. They can increase the antioxidant capacity of blood. In view of increasing risk factors of human to various deadly diseases, there has been a global trend toward the use of natural substance present in medicinal plants and dietary plants as therapeutic antioxidants. It has been reported that there is an inverse relationship between the dietary intake of antioxidant-rich food and medicinal plants and incidence of human diseases. A number of scientific studies are addressing the varied health benefits of antioxidant supplementation in processes like stress, ageing, pathogen infestation, reduce cell damaging effects, apoptosis and neurological diseases of free radicals. Certain synthetic antioxidants like butylated hydroxytoluene (BHT) and butylated hydroxy anisole (BHA) also reduce oxidation, but they have been reported dangerous to mankind, therefore investigation for non-toxic antioxidants have intensified in the recent years.

KEYWORDS: Antioxidants are the substances that may protect cells from the damage caused by free radicals.

INTRODUCTION

The plants and their products are found throughout human history as herbal supplements as botanicals, nutraceuticals, and drugs. In whole population of the world, about 60– 80% of the population still relies on conventional medicine for the healing of familiar diseases. Plants have been found of great importance due to their medicinal and nutritional properties with a primary source of bioactive compounds. Natural antioxidants are commonly derived from plant sources, and the growing environment. The mode of action for these substances will vary depending upon the source material. It is necessary to study the medicinal plants with folklore position in a number of intensified ways to encourage the utilization of herbal medicine and to find out their potential as a source of new medicines. Today herbal medicine signifies one of the most essential fields of folk medicine and the utilization of herbal medications have been growing popularity for various therapeutic conditions. Total phenolics, antioxidant, antitumor, and enzyme inhibitory activity of Indian medicinal and

aromatic plants extracted with different extraction methods. There is growing tendency in herbal products. Because of the effective pharmacological activities, economic viability and low toxicity, the therapeutic properties of plants have been examined throughout the world. Plants contain a variety of bioactive compounds with antioxidant capabilities including flavonoids, phenolics, sterols, alkaloids, carotenoids and glycosylates.

Antioxidants

An antioxidant is a molecule stable enough to donate an electron to a rampaging free radical and neutralize it, thus reducing its capacity to damage. It acts as radical scavenger, H doner, electron doner, peroxide decomposer, enzyme, inhibitor and metal chelating agent. In the last decade, preventive medicine has undergone a great advance, especially in developed countries. Research has demonstrated that antioxidant plays a crucial role in the prevention of chronic diseases, as most of them can be found in food and plants.

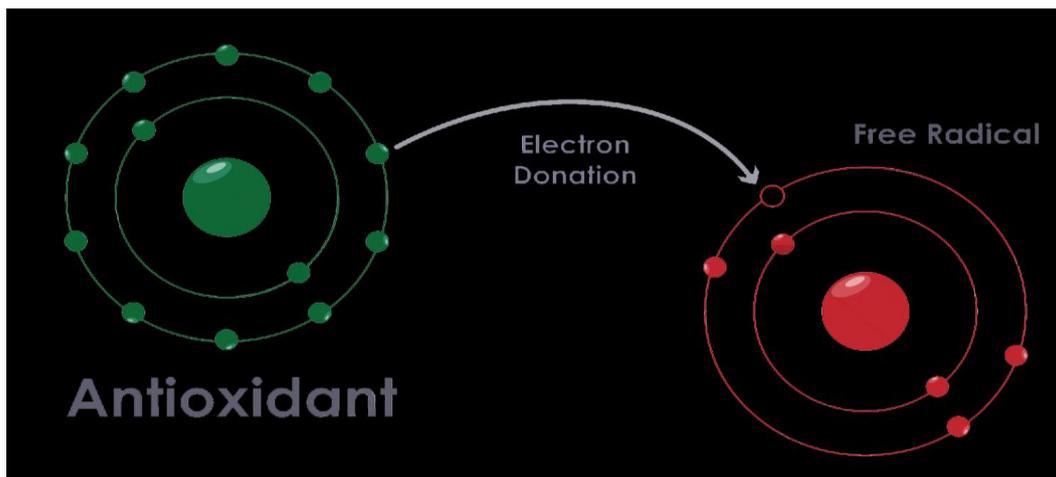


Figure 1: Antioxidant & free radical.

Classification of antioxidants

Antioxidant can be classified into two major groups based on their source^[3] -

1. Natural antioxidant
2. Artificial antioxidant

1. Natural antioxidant- It can be synthesized in human body or can be supplied through natural source. They are two subdivision-

- (a) Enzymatic
- (b) Non-enzymatic

(a) Enzymatic- They are produced in human body and can be subdivided into primary and secondary antioxidant.

Primary antioxidants are superoxide dismutase(sod), catalase (CAT), Glutathione peroxide (GPX) Secondary antioxidant are Glutathione reductase (GR), Glucose -6-phosphate dehydrogenase(G6PDH).

(b) Non-enzymatic- They are a class of antioxidants which are not found in the human body naturally but are required to be supplemented for the proper metabolism.

- Non-enzymatic antioxidants are-
- Mineral-selenium, copper, iron, zinc, manganese
 - Ascorbic acid
 - Glutathione
 - Melatonin
 - Tocopherol and tocotrienols (vitamin E)

(ii) Synthetic Antioxidant- Artificial antioxidants are not synthesized in the body, synthesized in industry-

- Butylated Hydroxy anisole (BHA)
- Butylated Hydroxytoluene (BHT)
- Propyl Gallate(PG)
- Tert-butyl hydroquinone (TBHQ)

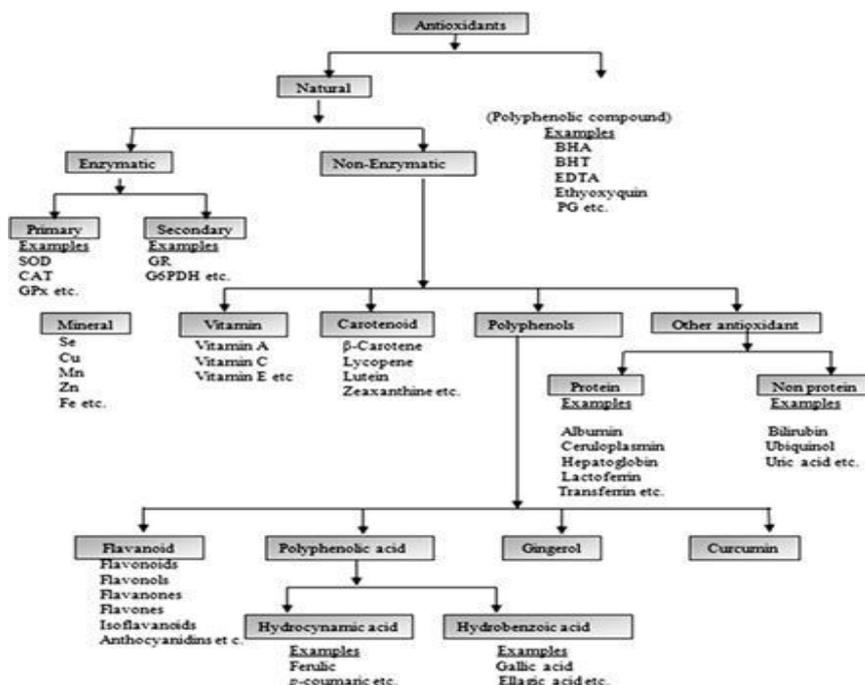


Figure 2: Classification of Antioxidants.

Free radicals

The ROS can be produced from either endogenous or exogenous sources. The endogenous sources of ROS include different cellular organs such as mitochondria, peroxisomes and endoplasmic reticulum where the oxygen consumption is high. There are three known free

radicals, the superoxide, the hydroxyl and peroxide. some exogenous sources which can responsible for oxidative stress are trauma, injury, smoking, radiation, mental stress, certain drugs, insomnia, unhealthy lifestyle, unhealthy food and dietary habits etc.^[5]

Table 1: Free Radicals.

Physiological factors	Environmental factors
Energy metabolism	Air pollution
Diabetes	Asbestos
Exercise	High levels of vitamin C
Acute illness	High levels of oxygen
Immune responses	Radioactive emissions
Injury	Some herbicides
Obesity	Tobacco smoke
Xenobiotics	Drugs and additives
Other diseases	Trace minerals (iron, copper)
Other metabolic reactions	Ultraviolet light rays

Effects of Free radicals: Free radicals and reactive oxygen species mediated damage in human body.^[5]

Table 2: Effects of free radicals.

Site of Damage	Pathological Changes
DNA	Strands breaks leading to mutation and cancer
Nucleotides, thio dependent enzymes, protein cross linking	ii. Metabolic disturbances inflammation, diabetes, cardiac disease, asthma
iii. Extracellular macromolecules-Hyaluronic acid, membranes lipid peroxidation.	iii. Joint disease, allergy, inflammation, oedema, reduce immunity.

Reactive oxygen species and their effective antioxidants^[5]

Table 3: ROS and their effective antioxidants.

	Reactive Species	Antioxidants
O ₂	Singlet Oxygen	Vitamin A, beta-carotene, vitamin C
O ₂ ⁻	Superoxide free radical	Superoxide dimutase, vitamin E, beta-carotene
OH ⁰	Hydroxyl free radical [OH ⁻]	
RO ⁰	Alkoxyl free radical [RO ⁻]	
ROO ⁰	Peroxyl free radical	Vitamin E, vitamin C
H ₂ O ₂	Hydrogen peroxide	Catalase, glutathione peroxidase
LOOH	Lipid peroxides	Glutathione peroxidase

Antioxidant defence system

Antioxidant acts as a free radical scavenger. Free radicals are chemical species with one or more unpaired electrons in their outer or wider. Both enzymatic and non-enzymatic antioxidants exist in intracellular and extracellular environments to detoxify Reactive Oxygen Species (ROS).

Levels of antioxidant action

(i) First line of defense- It is the preventive suppress the formation of free radicals. The exact mechanism of free radicals. The exact mechanism of these antioxidant is not clear but they suppress the reaction to reduce the generation of hydrogen peroxide(H₂O₂), hydroperoxide, glutathione peroxide, glutathione-s-transferase, phospholipid hydroperoxide glutathione peroxidase (PHGPX) and some peroxides to corresponding alcohol.

(ii) Second line of defense- This antioxidant scavenge the active radicals to substance chain initiation and/or break the chain propagation reaction. Vitamin C, Uric acid, Bilirubin, thiols(S containing materials) are radical scavenging hydrophilic molecules.

(iii)Third line of defense- The third line of defence is the repair and denovo antioxidant. The protolytic enzymes, proteinases, proteases, peptidase present in the mitochondria of mammalian cell recognise degrade and remove of oxidatively modified protein and prevent the accumulation of oxidised protiens.

Requirements of Antioxidants

Three daily serving of vegetables and two of fruits are recommended to fulfill, these antioxidant vitamin

requirement. It is advised to intake of 500-600g/day of antioxidant rich food.^[5]

Sources of Antioxidants

1. Antioxidants from dietary food

Regular utilization of fruits and vegetables is documented to diminish the risk of chronic ailments. Populace obtain supplements of antioxidant directly from fresh fruits and vegetables, as they contain a huge quantity of flavonoids and antioxidant complements which can take part in the defence mechanisms against different cardiovascular ailments including different types of cancers and many health problems. Studies reveal that a diet with rich antioxidants has an affirmative impact on health on a large scale. Wide variety of plants and plant parts have been demonstrated to contain a large amount of antioxidants such as strawberries, Blueberries, grapes, spinach, plums, broccoli flowers, alfalfa sprouts and many more, and they are also integrated into many dietary ingredient. Citrus fruits like lemons, oranges etc. also contain a high quantity of natural antioxidants, most significantly vitamin C.

Moreover there are some new and distinctive antioxidants like derivatives of flavonoids and p-coumaric acid that have been discovered in spinach. NAO- a spinach-derived natural antioxidant that contains derivatives of flavonoids and p-coumaric acid has a beneficial biological activity in the prevention of prostate cancer. Recently it has been revised that fruits like araticudomato, pindo palm and jackfruit are good sources of vitamin C, vitamin A and other phenolic compounds, analysis on these fruits is being carried out to create the genetic, chemical or biological variations so as to enhance the antioxidant potential of the same.

Antioxidant compound obtained from regular dietary food that are-

Vitamin A: Dairy produce, eggs, and liver

Vitamin C: Most fruits and vegetables, especially berries, oranges, and bell peppers

Vitamin E: Nuts and seeds, sunflower and other vegetable oils, and green, leafy vegetables

Beta-carotene: Brightly colored fruits and vegetables, such as carrots, peas, spinach, and mangoes.

Lycopene: Pink and red fruits and vegetables, including tomatoes and watermelon

Lutein: Green, leafy vegetables, corn, papaya, and oranges

Selenium: Rice, corn, wheat, and other whole grains, as well as nuts, eggs, cheese, and legumes.

Polyphenols: Found in all plant foods especially strawberry, raspberries, blackberries.

Flavonoids: Apple, pears, cherries, grapes, citrus fruits, onion, broccoli, tea.

Terpenes: Citrus fruits, carrots, parsley, broccoli, cabbage, cucumber.

Resveratrol: Red grapes, pomegranate, red wine.

Other dietary foods also provide antioxidant. Nutraceuticals also provide antioxidant. Nutraceuticals are natural and categorized as :

Dietary fibre

Probiotics

Prebiotics

Poly unsaturated fatty acids

Spices.^[1,5]

2. Antioxidant from plants

The use of synthetic and natural food antioxidants regularly in medicine and foods particularly those having fats and oils to shield the food from oxidation. Butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) are the synthetic and natural food antioxidants which have been used extensively in cosmetic, food and therapeutic industries. But, owing to their instability at high temperatures, high volatility, synthetic antioxidant's carcinogenic behaviour, users inclinations led to shift in the consideration of producers or manufacturers from man-made to natural antioxidants. In consideration of growing risk issues of humans to various lethal diseases, there has been a universal trend in the direction of the use of natural substances present in dietary and medicinal plants as curative antioxidants. A variety of medicinal plants have been reported to reveal antioxidant activity, including *Allium sativum*, *Zingiber officinale*, *Crocus sativus*, *Dodonaea viscosa*, *Barleria noctiflora*, *Anacardium occidentale*, *Datura fastuosa*, *Caesalpinia bonducella* and many more. Numerous antioxidants identified as active oxygen scavengers or free radicals, obtained naturally from the plant sources are used in food, cosmetic and remedial purposes proved to be brilliant alternatives for man-made antioxidants because of their inexpensiveness, and have no any harmful effect on human body. In order to defy the detrimental effects of reactive oxygen species, plants have a powerfully built enzymatic and non-enzymatic scavenging pathway. Enzymes included are catalase (CAT), superoxide dismutase (SOD), ascorbate peroxidase (APX), glutathione reductase (GR), glutathione S-transferase (GST), dehydroascorbate reductase (DHAR), monodehydroascorbate reductase (MDHAR), peroxidases (POX) and glutathione peroxidase (GPX). Non enzymatic compounds include glutathione (GSH), carotenoids, tocopherols and ascorbate (AsA). There are unambiguous, well synchronized ROS generating and scavenging systems present in different organelles of the plant cells. Lesser levels of ROS comparatively act as signalling essences that arouses abiotic stress tolerance by altering the expression of resistant genes. In plants, elevated levels of antioxidants have been accounted to demonstrate better resistance to different types of environmental stresses.^[1]

Table no. 4: Vegetables with antioxidant amount.^[8]

Vegetables	Antioxidant activity mg/100g
Beans	83
Brinjal	150
Cabbage	78
Capsicum	96
Cauliflower	66
cluster beans	102
cucumber	63
pumpkin	38
beetroot	125
carrot	11
onions	23
sweet potato	25

Supplements

Antioxidant supplements contain concentrated forms of antioxidants. Antioxidant supplements contains 70-60% of the daily value of the antioxidants. antioxidant supplements prevents the damage caused by free radicals and prevent many diseases. Taking a large doses of antioxidant supplements ha harmful effect on health. Some study shown that antioxidant supplement mainly vitamin C and E has many benefits. But some antioxidant supplement may reduce the health benefits of exercise and increase the risk of certain cancer and birth defects. It is recommended that antioxidant requirement of body is met through diet not in the form of supplements. Vitamin C is a good remedy for common cold and cough, but when it is given in the form of supplement it may be discourage. So instead of supplement it is advised that antioxidant rich food in regular diet is much more beneficial and safe.^[7]

Benefits of antioxidants

Antioxidant came to public attention in 1990s. free radicals involves in artery-clogging atherosclerosis, cancer, vision loss and other chronic diseases. Antioxidant plays a major role in the prevention of many diseases^{[4] [6] [2]}.

(i) **Heart disease**-Vit E, β -carotene and other antioxidant has a effective role against the prevention of cardiovascular disease.

(ii) **Cancer**-Vitamin E prevents the transformation of carcinogenic precursor compound. folic acid, Vitamin A and Vitamin C have protective role at molecular level in cancer development.

(iii) **Age related eye diseases**-Lutein, Zeaxanthin, Vit E supplementation have some effective role in age-related macular degeneration (AMD).

(iv) **Cognition**- β -carotene long term supplementation provides cognitive benefits.

(v) **Oxidative stress**-Vit E protect the body against free radical damages. Several observation suggested that antioxidant should be able to prevent oxidative damage in humans who consume fruits and vegetables

CONCLUSION

Cellular damage arising from free radicals or reactive oxygen species (ROS) now appears the fundamental mechanism underlying a number of human neurodegenerative disorders, diabetes, inflammation, viral infections, autoimmune pathologies and digestive system disorders. It has been revealed from large number of experimental studies that free radicals and reactive oxygen species are involved in these disorders. Various man-made antioxidants are used in processed diets to overcome such ailments, but they exhibit side effects. Numerous indigenous antioxidants may be valuable in stopping the detrimental effects of oxidative stress. This has led to considerable attention in calculating the antioxidant capacity of foods, botanicals and other nutritional antioxidant supplements. In the present review some medicinal plants e.g., *Allium sativum*, *Artemisia campestris*, *Zingiber officinale*, *Crocus sativus*, *Dodonaea viscosa*, *Barleria noctiflora*, *Anacardium occidentale* etc are tabulated which have been reported to possess a potent antioxidant properties as they contain a large number of bioactive compounds like flavonoids, phenolics etc. in addition to antioxidant activity these compounds are also used as anticarcinogenic, antifungal, antibacterial, anti-spasmodic, anti-inflammatory and anti-diabetic.

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