www.ayurpharm.com
ISSN: 2278-4772

Ayurpharm Int J Ayur Alli Sci., Vol. 7, No. 5 (2018) Pages 70 – 76

Review Article

TABLE TO GUT – ANTIOXIDANTS

Smitha Bhat US[1*], Waheeda Banu[2]

1. *PG Scholar, Dept. of Swasthavritta & Yoga, Alva's Ayurveda Medical College, Moodabidri, Karnataka, India.*
2. *Head, Dept. of Swasthavritta &Yoga, Alva's Ayurveda Medical College, Moodabidri, Karnataka, India.*

Received: 17-05-2018; Revised: 27-05-2018; Accepted: 29-05-2018

Abstract

Over the centuries man has evolved depending on nature for food, shelter and living. Diet being the integral part of mankind plays a pivotal role in management of health. Antioxidants are type of nutraceuticals which can be a molecule or other organic substance as vitamin C & E, beta carotene, lycopene, capable of counteracting the damaging effects of oxidation in animal tissues. Antioxidants reduce the effects of free radicals; it counteracts the cell damage caused by stress, drugs and toxicity produced due to chemical exposure. The food products which are rich in antioxidants are gooseberries, tomato, green leafy vegetables, carrot and citrus fruits. Deficiency of antioxidants may lead to manifestation of diseases like cancer, Alzheimer's disease, Rheumatoid arthritis. Oxygen Radical Absorbance Capacity (ORAC) is a lab test that attempts to quantify the total antioxidant capacity (TAC) of a food by placing a sample of the food in a test tube, along with certain molecules that generate free radical capacity and certain other molecules that are vulnerable to oxidation. Ayurveda explains the importance of Rasayana which induce immune stimulation and improves defense mechanisms against free radicals. Rasayana aims at improving the metabolic processes which result in best possible biotransformation and promotes health. Nitya Sevaniya Ahara explained in our classics include Amalaki, Ksheera and Gritha which are rich in antioxidants.

Key words: Antioxidant; Rasayana; Free radicals; Nutraceuticals.

***Address for correspondence:**
Dr. Smitha Bhat US,
PG Scholar,
Dept. of Swasthavritta & Yoga,
Alva's Ayurveda Medical College,
Moodabidri, Karnataka, India – 574 227
E-mail: drsmithapbhat@gmail.com

Cite This Article

Smitha Bhat US, Waheeda Banu. Table to gut – Antioxidants. Ayurpharm Int J Ayur Alli Sci. 2018;7(5):70-76.

www.ayurpharm.com
ISSN: 2278-4772
Ayurpharm Int J Ayur Alli Sci., Vol. 7, No. 5 (2018) Pages 70 – 76

INTRODUCTION

Rasayana (rejuvenation) is one of the eight major specialties of Ayurveda which acts as a preventive, curative and health promote for all ages. It is well known for its anti-degenerative, rejuvenate property which prevents the effects of aging and improves the quality of life. The term Rasayana comprises of 2 terms Rasa and Ayana. Rasa means Sapta Dhatu and Ayana means movement or channel. Rasayana is the measure which prolongs longevity, develops positive health and provides resistance against disease. Ayurveda explains different Rasayana based on its action like Medhya Rasayana (memory booster); Rasayana acting on various levels like Srotas (channels), Dhatu, disease specific, according to Dehaprakriti (body constituency) and Kala (season).

In the present days of advanced scientific achievements, a new branch evolved named as Nutraceuticals. It involves antioxidants, probiotics, prebiotics, dietary fibers, omega 3 fatty acids. Antioxidants are those substances which counteracts on free radicals and thereby cell damage is controlled. Antioxidants are helpful in the prevention of diseases which are manifested due to the DNA damage caused by oxidative stress, drugs, toxicity produced due to chemical exposure. Deficiency of antioxidants may lead to the manifestation of the disease like Alzheimer's disease, Rheumatoid arthritis, Cancer.

Nutraceuticals

According to De Felice, Nutraceutical is defined as "a food or part of a food that provides medical or health benefits, including the prevention and/or treatment of a disease." However the term nutraceutical as commonly used in marketing has no regulatory definition. Phytochemicals and antioxidants are the specific types of nutraceuticals.

MATERIAL AND METHODS

This article is based on the review of Ayurvedic and modern texts along with researches related to the topic. Materials related to antioxidants and Rasayana and other topic have been collected.Various research activities conducted on various Ayurvedic drugs explain the presence of antioxidants which have a major role in the Rasayana action of the drugs.

Antioxidants

As the word itself says antioxidant is a substance which counteracts on oxidation process. Oxidation reactions produce free radicals that can start multiple chain reactions which damages the cell. Antioxidants remove these free-radical intermediates by being oxidized themselves, and inhibit other oxidation reactions, thus stopping the harmful chain reactions. Spontaneous oxidation causes food rancidity and spoilage of medicines.

The definition of antioxidants, given in 1995 by Halliwell and Gutteridge, stated that an antioxidant is "any substance that, when present at low concentrations compared with that of an oxidizable substrate, significantly delays or inhibits oxidation of that substrate"[1]

Classification of Antioxidants

- Based on its chemical constituents, antioxidants are classified as Enzymatic Antioxidants& Non Enzymatic Antioxidants. Enzymatic Antioxidants are again sub divided as Primary enzymatic defense and Secondary enzymatic defense.
- Based on its origin, antioxidants are of 2 types Endogenous and Exogenous.
- Based on solubility antioxidants are of 2types namely fat soluble (Ex: Vitamin E) & Water soluble (Ex: Vitamin C)

www.ayurpharm.com
ISSN: 2278-4772
Ayurpharm Int J Ayur Alli Sci., Vol. 7, No. 5 (2018) Pages 70 – 76

Endogenous antioxidants

These are those antioxidants which are produced within the body.
Eg: glutathione, lipoic acid

Exogenous antioxidants

These are the antioxidants which are available from the food we consume.
Eg: Vitamin C, Vitamin E, beta carotene, xanthophylls, lycopene, flavonoids

Enzymatic antioxidants

These antioxidants functions at the intracellular level. As the name itself suggests various enzymes are involved in this type of anti-oxidation process.

Primary enzymatic defense antioxidants

The primary defense is composed of three important enzymes that prevent the formation of and neutralize free radicals:

i) Glutathione peroxidase
ii) Catalase
iii) Superoxide dismutase (SOD)

Glutathione peroxidase donates two electrons or hydrogen atom to reduce peroxides by forming selenols and also eliminates peroxides as potential substrates for the Fenton reaction thereby protects the cells against free radicals.[2]

Catalase is one of the most important and efficient antioxidants known today which is present in the peroxisome of aerobic cells. It turns hydrogen peroxide into water and molecular oxygen.Just one molecule of catalase can convertapproximately 6 billion molecules of hydrogen peroxide (Mates et al).[3]

Superoxide dismutase is intracellular enzymatic antioxidants which catalyzes the conversion of superoxide anions to dioxygen and hydrogen peroxide as a substrate for subsequent catalase action. It neutralizes superoxide ions by going through successive oxidative and reductive cycles of transition metal ions at its active site (Chaudière and Ferrari-Iliou (1999).

Secondary enzymatic defense antioxidants

i) Glutathione reductase
ii) Glucose-6-phosphate dehydrogenase.

Glutathione is a water soluble antioxidantwhich is synthesized from the amino acids glycine, glutamate and cysteine. Glutathione reductase reduces glutathione to its reduced form tohelp in neutralizing more free radicals.[4]

Glucose-6-phosphate regenerates NADPH (nicotinamide adenine dinucleotide phosphate - coenzyme used in anabolic reactions) to create a reducing environment.

These two enzymes support the primary enzymatic defense antioxidants and do not neutralize free radicals directly and hence they are secondary enzymatic defense antioxidants [5].

Non enzymatic antioxidants

The group of non-enzymatic antioxidants contains several subgroups, the main ones being:

i) Vitamins (A, E, C),
ii) Enzyme cofactors (Q10),
iii) Minerals (zinc and selenium),
iv) Flavonoids
v) Carotenoids
vi) Peptides (glutathione), phenolic acids, and
vii) Nitrogen compounds (uric acid)

www.ayurpharm.com
ISSN: 2278-4772
Ayurpharm Int J Ayur Alli Sci., Vol. 7, No. 5 (2018) Pages 70 – 76

Synthetic antioxidants

These compounds are added in order to prolong the shelf life of the product, prevent the oxidation process thereby prevent the rancidity of the product.

Common synthetic antioxidants used are as follows: Butylatedhydroxyanisole (BHA), Butylated hydroxyl- toluene (BHT), Propyl gallate, Tert-Butylhydroquinone (TBHQ), Ascorbic acid derivatives, such as ascorbic acid and erythorbic acid, Thiol derivatives such as thioglycerol, cysteine, dithiothreitol, and glutathione, Sulphurous acid salts, such as sodium sulfite, sodium formaldehyde sulphoxylate, and tocopherols.

The European Food Safety Authority (EFSA) evaluated information regarding many such synthetic antioxidants and established revised acceptable proper scale for food companies for daily intakes of antioxidants for human consumption.[6]

Sources of antioxidants

Sources of antioxidants are enlisted in Table 1.

Free radicals

Free radicals are atoms, molecules or ions with unpaired electrons that are highly unstable and active towards chemical reactions with other molecules like proteins, lipids and nucleic acids. It can be defined as reactive chemical species having a single unpaired electron in an outer orbit (Riley1994).

They are derived from 3 elements: oxygen, nitrogen and sulphur thus creating reactive oxygen species (ROS), reactive nitrogen species (RNS) and reactive sulphur species (RSS).

Benefits of antioxidants

1) Antioxidants benefit the body by neutralizing and removing the free radicals from the blood stream.
2) Antioxidants counteract the cell damage caused by stress, drugs, toxicity produced due to chemical exposure.
3) Antioxidants help in the prevention of manifestation of the diseases like Cancer, Alzheimer's disease and Rheumatoid Arthritis.
4) Beta-carotene and other carotenoids are beneficial to eyes.
5) Astaxanthin followed by beta-carotene combined with vitamin E has been shown to be one of the most powerful antioxidant combinations to protect the skin from reactive species of oxygen.
6) Flavonoids have been demonstrated to have anti-inflammatory, anti- allergenic, anti-viral, anti-aging, and anti-carcinogenic activity.In addition to an antioxidant effect, flavonoid compounds may exert protection against heart disease through the inhibition of cyclooxygenase and lipoxygenase activities in platelets and macrophages.
7) Vitamin C is a co-factor in enzymatic reactions and several collagen syntheses. It is an electron donor, in enzymatic reactions because of which it is a potent water-soluble antioxidant in humans. If these reactions are disrupted or damaged, they can cause severe health problems, such as scurvy.[7] Furthermore, studies showed that some gene expression and protein assimilation functions are dependent on dietary vitamin C.[8]
8) Vitamin E is a fat-soluble antioxidant, stops the production of ROS formed due to fat oxidation.It also functions in cell signaling, immune system, gene expression regulation and other metabolic processes.[9]

www.ayurpharm.com
ISSN: 2278-4772
Ayurpharm Int J Ayur Alli Sci., Vol. 7, No. 5 (2018) Pages 70 – 76

Table 1: Sources of antioxidants

Sl. No.	Antioxidants	Source
1	Vitamin C	Citrus fruits like orange, lemon, green leafy vegetables
2	Vitamin E	Grains, nuts, almond, green leafy vegetables
3	Beta carotene	Carrots, spinach, sweet potato
4	Lycopene	Tomato
5	Xanthophyll	Sweet potato, cabbage, spinach, peas, beans
6	Flavonoids	Onion, almonds, watermelon, tomato

9) Glutathione quenches Reactive Oxygen Species such as lipid peroxides, and has a major role in xenobiotic metabolism by which body removes xenobiotic. When an individual is exposed to high levels of xenobiotic, more glutathione is utilized for conjugation which is a key step in the body's detoxification process.[10] Liver when exposed to xenobiotic substances induces oxidative reactions through the up regulation of detoxification enzymes, i.e., cytochrome P-450 mixed-function oxidase.
10) Lipoic acid, an endogenous antioxidant, is a sulphurcontaining molecule that catalyzes the oxidative decarboxylation of alpha-keto acids, such as pyruvate and alpha- ketoglutarate, in the Krebs cycle. Lipoic acid and its reduced form, dihydrolipoic acid (DHLA), quench free radicals in both lipid and aqueous domains and hence is called as a "universal antioxidant."Lipoic exert its antioxidant effect by chelating with prooxidant metals. Research further suggests that lipoic acid has a sparing effect on other antioxidants.[11] Animal studies have demonstrated supplemental lipoic acid to protect against the symptoms of vitamin E or vitamin C deficiency.[12]
11) It has been estimated that dietary increases in antioxidant vitamins may reduce the risk of heart disease by 20-30%.[13]
12) Oxidants stimulate cell division, a factor in mutagenesis. When a cell with a damaged DNA strand divides, cell metabolism and duplication becomes deranged. Thus, a mutation can arise which in turn is an important factor in carcinogenesis.

It is believed that antioxidants exert their protective effect by decreasing oxidative damage to DNA and by decreasing abnormal increases in cell division. Well over 100 studies have reported that reduction in cancer risk is associated with a diet high in vitamin C.[14]

Effects of cooking on antioxidants

Cooking methods involve boiling, microwaving, pressure cooking, grilling, frying, roasting, baking, sautéing, blanching and steaming.

1) Pressure cooking and boiling lead to greater loss compared to other types.
2) Microwaving preserved on average of 97.3% of the antioxidants in vegetables.
3) Depending on the vegetables the antioxidant loss during cooking varies.

- Carrots increase their antioxidant value after cooking.
- Bell pepper, cauliflower loses antioxidants on all cooking methods
- Asparagus beetroots do not get affected by any of the cooking methods.

ORAC Oxygen Radical Absorbance Capacity

Oxygen Radical Absorbance Capacity (ORAC) is a lab test that attempts to quantify the total antioxidant capacity (TAC) of a food by placing a sample of the food in a test tube, along with certain molecules that generate free radical capacity and certain other molecules

www.ayurpharm.com
ISSN: 2278-4772
Ayurpharm Int J Ayur Alli Sci., Vol. 7, No. 5 (2018) Pages 70 – 76

that are vulnerable to oxidation. It is a unit of measurement for antioxidant content which was originally developed by the National Institute of Aging at the National Institute of Health. Some of the examples for food with high ORAC are as follows

Triphala - 7, 06250, Amalaki - 2, 61500, Haridra - 1, 27068, Yastimadhu - 1, 02945

DISCUSSION

Rasayana is one which nourishes the Rasadi Dhatus, Acharya Chakrapani clarified on the word Rasadinam as Rasadi Saptadhatu and Shasthanam as Prashasta Dhatu.[15] Some of the examples for Rasayana are Guduchi (*Tinospora cordifolia* Willd), Lashuna (*Allium sativum* Linn.), Guggulu (*Commiphora mukul*), Amalaki (*Emblica officinalis* Gaertn), milk, Ghritha (ghee).

- Rasayana induce immune stimulation and improves defense mechanisms against free radicals. It improves the metabolic processes which result in best possible biotransformation and promotes health.
- Rasayana works at the level of Rasa (nutrient value of plasma) by enriching the nutritional value of circulatory plasma, example: Draksha (grapes), Ksheera (milk), Shatavari (*Asparagus racemosus* Willd).
- At the level of Agni (digestion and metabolism) by improving the digestion and metabolism leading in turn to improved nutritional status. Example: Pippali (*Piper longum* Linn.), Haritaki (*Terminalia chebula* Retz.), Chitraka (*Plumbago zeylanica* Linn.)
- Rasayana acts at the level of Srotas that is the micro circulatory channels carrying nutrition to the tissues; these Rasayanas clean and activate the micro circulatory channel that is Srotoshuddi leading to improve microcirculation. Example: Guggulu (*Commiphora mukul*)
- It maintains the homeostasis and improves the longevity, removes the free radical oxidants and intermediate metabolites, improves immunity, mental competence, and psychosomatic coordination.

Benefits of Rasayana

Regular practice of Rasayana benefits are: Deerghayu - helps in the longevity of life; Dehaendriya balam - improves the strength of the body and senses; Smriti - enhances memory; Vaaksiddhi - improves the voice; Medha - intellectual ability is empowered; Pranati - Loka Vandyata - person will be well identified by the society; Taruna vaya - biological aging is delayed; Kaanthi - body lusture is enhanced

Nityasevaniya ahara

The food to be taken regularly is said to be Nitya sevaniya Ahara or Nitya rasayana include Shastika shali (rice), Mudga (green gram), Saindhava (rock salt), Amalaki (Emblica officinalis Gaertn.), Antariksha Jala (rain water), Ksheera (milk), Jaangala mamsa and Madhu (honey).[16] These are rich in antioxidants and hence it is explained in the classical literature that the regular intake of these Nitya rasayana will be helpful in maintenance of health.

Research works on Amalaki done by Vasudha Shukla, Manish Vashistha and Somnath Singh reveals the presence of antioxidants as: The vitamin C content of Amalaki was found to be 5.38 mg/g.[17] Khopde et al. have reported vitamin C content as high as 44.65 mg/g of Amla by using titrimetric method. Khopde et al. have also estimated vitamin content by using HPLC and by this method content was found to be 32.5 per g of Amalaki.[18]

www.ayurpharm.com
ISSN: 2278-4772
Ayurpharm Int J Ayur Alli Sci., Vol. 7, No. 5 (2018) Pages 70 – 76

CONCLUSION

Antioxidants being the branch of nutraceuticals have a vital role in health maintenance and promotion. The daily food intake which is rich in antioxidants helps to improve the immunity and fights against disease causing factors which increase the production of free radicals. Ayurveda gives importance to the Swasthya Rakshana (maintenance of health) and Roga prashamana (curing disease). It explained the importance of Rasayana which are rich in antioxidants.

REFERENCES

1. Halliwell B, Gutteridge JMC. The Definition and Measurement of Antioxidants in Biological Systems. Free Radical Biology and Medicine. 1995;18(1):125-126.
2. Carocho M, Ferreira ICFR. A Review on Anti-oxidants, Prooxidants and Related Controversy: Natural and synthetic compounds. Screening and Analysis Methodologies and Future Perspectives. Food and Chemical Toxicology. 2013;51:15-25.
3. Rahman K. Studies on Free Radicals, Antioxidants, and Co-Factors. Clinical Interventions in Aging. 2007;2(2):219-236.
4. Ratnam DV, Ankola DD, Bhardwaj V, Sahana DK, Kumar MNVR. Role of Antioxidants in Prophylaxis and Therapy: A Pharmaceutical Perspective. Journal of Controlled Release, 2006;113(3);189- 207.
5. Yevgenia Shebis, et al. Natural Antioxidants: Function and Sources Food and Nutrition Sciences, 2013;4:643-649.
6. EFSA, Scientific Opinion on the Reevaluation of Butylated Hydroxytoluene BHT (E 321) as a Food Additive. EFSA Panel on Food Additives and Nutrient Sources Added to Food (ANS). European Food Safety Authority Journal. 2012;10(3):2588. Retrieved from: http://www.efsa.europa.eu/en/efsajournal/doc/2588.pdf [Accessed on: 18/02/2017]
7. Padayatty SJ, Katz A, Wang YH, Eck P, Kwon O, Lee JH, et al. Vitamin C as an Antioxidant: Evaluation of Its Role in Disease Prevention. Journal of the American College of Nutrition, 2003; 22(1):18-35.
8. Lucock M, Yates Z, Boyd L, Naylor C, Choi JH, Ng X, et al. Vitamin C - Related Nutrient Gene Interactions that Modify Folate Status. European Journal of Nutrition. 2013;52(2):569- 582.
9. Salinthone S, Kerns AR, Tsang V, Carr DW. Alpha-Tocopherol (Vitamin E) Stimulates Cyclic AMP Production in Human Peripheral Mononuclear Cells and Alters Immune Function. Molecular Immunology. 2013;53(3):173-178.
10. Mark Percival. Antioxidants. Clinical Nutrition Insight. Advanced Nutrition Publications.1996; 1/96.
11. Packer L, Witt EH. Antioxidant Properties and Clinical Implications of Alpha-Lipoic Acid. In Packer L. and Cadenas E. eds. Biothionls in Health and Disease. New York: Marcel Dekker, Inc.; 1995. p.479-516.
12. Kagen VE, et al. Dihydrolipoic Acid–A Universal Antioxidant both in the Membrane and in the Aqueous Phase. Biochem Pharmacol. 1992;44:1637-1649.
13. Hennekens CH, Gaziano JM. Antioxidants and Heart Disease: Epidemiology and Clinical Evidence. Clin Cardiol. 1993;16(suppl I):I-10, I-15.
14. Fontham ET. Vitamin C, Vitamin C - Rich Foods and Cancer. Epidemiologic Studies. Ch 6: 157-197.
15. Charaka. Charaka Samhita (Chakrapani commentary). Yadavji Trikamji Acharya, editor. 3rd ed. Varanasi: Krishnadas Academy; 2000. Chikitsa Sthana, 1/1/7-8. p.376.
16. Charaka. Charaka Samhita (Chakrapani commentary). Yadavji Trikamji Acharya, editor. 3rd ed. Varanasi: Krishnadas Academy; 2000. Sutra Sthana, 5/12. p. 38.
17. Vasudha Shukla, Manish Vashistha, Somnath Singh. Evaluation of Antioxidant Profile and activity of Amalaki (*Emblica officinalis*), Spirulina and Wheat Grass. Indian Journal of Clinical Biochemistry, 2009;24(1):70-75.
18. Khopde MS, Priyadarsini K, Mohan H, Gawandi VB, Satav JG, Yakhmi JV, Banavaliker MM, Biyani MK, Mittal JP. Characterizing the antioxidant activity of Amla (*Phyllanthus emblica*) extract. Curr Sci. 2001;81:185-190.

Source of Support: Nil Conflict of Interest: None Declared