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THE ROLE OF ANTIOXIDANT FOODS, NUTRACEUTICALS AND HERBECEUTICALS IN ANTI-AGING AND CELLULAR LONGEVITY

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Abstract

The Longevity and anti-aging process are interesting scientific research topic today because non communicable disease are increasing in the society all around the world. Antioxidant, It is a molecule that inhibits the oxidation of other molecules. Damage to cells caused by free radicals is believed to play a vital role in the aging process and in disease progression. Antioxidants are our first line of defense against free radical damage and are critical for maintaining optimum health and wellbeing. The onset of all age-associated chronic disorders can be delayed because these pathologies share age as primary underlying risk factor. One of the most extended ideas is that aging is consequence of the accumulation of molecular damage. During the last decades several studies have examined the potential role of oxidative stress in the development of various diseases like cancer, Parkinson's disease, Alzheimer's disease, atherosclerosis, myocardial infarction, depression, type 2 diabetes and chronic fatigue syndrome etc. Oxidative stress can cause toxic effects through the production of peroxides and free radicals that damage all components of the cell, including proteins, lipids, and DNA. According to the oxidative damage theory, antioxidants should slow down aging process and extending lifespan. The concept of food and aging is of great concern to humans.

1. Introduction

Aging is a biological, degenerative process. It progresses slowly and is much more complicated to be measured quantitatively. Aging results in functional decline of organisms such as physiological functions with time and hence chances of death and disease rate are increased (Lee and Wei, 2012; Labat-Robert and Robert, 2015; Kauppila et al., 2017). Life expectancy has been significantly improved throughout the world over the last century which has been largely attributed to advances in public health practice, education and medicine (Vaiserman and Lushchak, 2017). It is generally assumed that if such demographic trend will continue then about 20 % of the global population will be older than 60 years

by 2050 (Kennedy and Pennypacker, 2014). However, this rise of life expectancy has not been accompanied, to date, by a similar increase in healthspan (Hung et al., 2011). Aging increases the risk for common chronic pathologies including type 2 diabetes mellitus, cardiovascular diseases, atherosclerosis, osteoporosis, neurodegenerative diseases, depression, rheumatoid arthritis, cancer and other metabolic-related diseases. Accordingly, with the rapid aging of the population in most of modern societies, the prevalence of aging-related pathological conditions will increase, representing a great socioeconomic problem (Beard and Bloom, 2015; Harper, 2014; Lopreite and Mauro, 2017).

Population aging can be minimized by the development of efficient health interventions, such as health education, disease-prevention and health-promotion programs that target major causes of morbidity and mortality in the elderly which allow to the population stays healthy until a very old age. (Lopreite and Mauro, 2017). It has been suggested that aging can be manipulated and if aging is modulated, the onset of all age-associated chronic disorders can be delayed because these pathologies share age as primary underlying risk factor (Austad, 2016; Sierra and Kohanski, 2017). Therefore, extension of the healthy life expectancy by slowing aging process is the most efficient way to combat aging-related chronic illnesses and disabling conditions representing serious medical, social and economic issue in modern societies. In this sense, interventions through changes in dietary patterns or using dietary supplements or nutraceuticals and herbaceuticals, in this sense, interventions through changes in dietary patterns or using dietary supplements or nutraceuticals specifically targeted at common mechanisms of aging, might be an effective way to prevent and fight against age-related pathologies. The present review studies estimating the effect of antioxidant Foods, Nutraceuticals and Herbeceuticals and discusses the favor of their antioxidant activity and the effect of anti-oxidant in anti-aging and cellular longevity.

2. Biology of aging and antioxidants

Aging is an unavoidable universal and biological phenomenon affecting all multicellular organisms (except with few) and probably common also among unicellular organisms, including protozoa, yeast, and bacteria (S. J. Lin and N. Austriaco, 2014; K. Książek, 2010 **)** Although different hypotheses have been put forward to explain the cellular and molecular mechanisms of aging, recent studies made it increasingly clear that aging is due to accumulation of molecular damage, giving rise to a unified theory of aging (K. A. Hughes and R. M. Reynolds: 2005; S. I. Rattan; 2006) Further, aging has been traditionally regarded as ‘natural’ and consequently unpreventable process, most present-day evolutionary theories postulate that aging has arisen as a by-product of fundamental evolutionary processes and does not have any specific function (Lemaître et al., 2015). Accordingly, it might be manipulated, and age-associated senescence may be regarded as a complex of pathophysiological processes that could be prevented, delayed or even reversed (Anton et al., 2005). Currently, the research attempted to enhance healthspan is focused primarily on slowing or postpone the biological processes underlying aging. This includes mitochondrial dysfunctions,

impaired proteostasis and stem cell function and maintenance, deregulated sensing of cell energy status and growth pathways, cellular senescence, age-related decrease in stress resistance, as well as oxidative and inflammatory stress (Fontana et al., 2014; Kirkland, 2016; Niedernhofer et al., 2017)

3. Oxidative stress

Oxidative damage means the accumulation of free radicals due to free radical's over-production that cannot be processed gradually or because of less availability of antioxidants. It leads to a wide range of random and indiscriminate bio-molecular damage. Term “oxidative stress” was first used in the 1970s & 1980s, for various processes. However, it was later called as antioxidants and oxidants imbalance in favor of the oxidants, which potentially leads to deterioration as shown in Figure 1. Oxidative stress occurs when the antioxidant buffering capacity is less than the production of pro-oxidant compounds such as ROS. The overabundance of ROS may initially enhance synthesis of concomitant cytokine and promote inflammation that can additionally accelerate the ROS formation (Umm-e-Ammara Warraich at al, Heliyon 2020; 6: 4107, homepage: www.cell.com/heliyo). Oxidative stress takes part in the development of aging and many degenerative and chronic disorders including autoimmune disorders, inflammation, cancer, arthritis, neurodegenerative and cardiovascular diseases. Oxidative stress could actively provoke many abnormalities so it leads to initiate many ailments (Chandrasekaran et al., 2017). Various pathophysiological events could occur due to disruption in bio-signaling because of oxidative stress and subsequent alterations at various levels of life, particularly in old age. The modulation of ROS location, inactivation and production occur continuously in both pathological and physiological conditions, if a fine balance is maintained between oxidant-antioxidant mechanisms (Umm-e-Ammara Warraich at al, Heliyon 2020; 6: 4107, homepage: www.cell.com/heliyo).

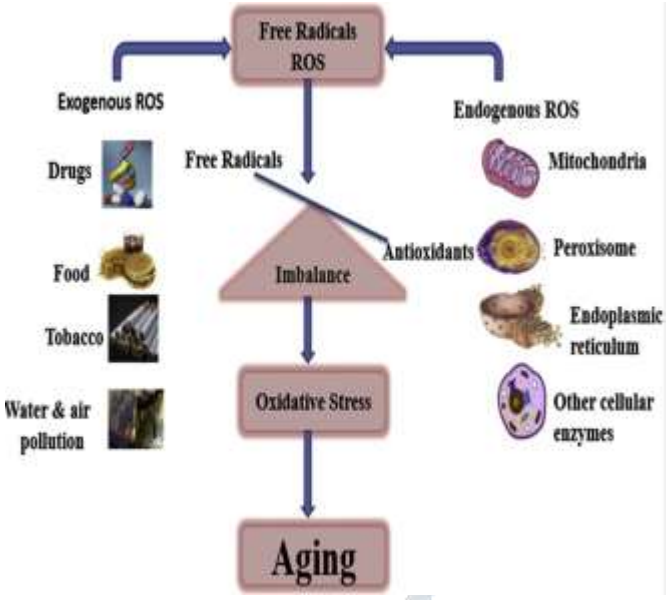

Figure: 1, Free radicals and antioxidants imbalance causes oxidative stress and results in aging, while several endogenous and exogenous ROS sources contribute to aging (Weidinger and Kozlov, 2015).

4. Antioxidant

Antioxidants are substances, which inhibit or delay oxidation of a substrate while present in minute amounts. Endogenous antioxidant defenses are both non-enzymatic and enzymatic (Table: 1). The most important source of antioxidants is provided by nutrition, many belonging to the phenol family.

Nutritional antioxidants act through different mechanisms and in different compartments,

But are mainly free radical scavengers:

1) They directly neutralize free radicals,

2) They reduce the peroxide concentrations and repair oxidized membranes,

3) They quench iron to decrease reactive oxygen species production,

4) Via lipid metabolism, short-chain free fatty acids and cholesteryl esters

Neutralize reactive oxygen species (Berger 2005).

Vitamin C is the major water-soluble antioxidant and acts as first defense against free radicals in whole blood and plasma. It is a powerful inhibitor of lipid peroxidation and regenerates vitamin E in lipoproteins and membranes. A strong inverse association has been shown between plasma ascorbic acid and isoprostanes Isoprostanes represent a family of prostaglandin isomers which, in contrast to classic prostaglandins formed through an enzymatic action of the prostaglandin-H-synthase from arachidonic acid, result from a free radical-catalyzed mechanism. For this reason, isoprostanes provide an optimal estimate of oxidative damage to cellular lipids and represent an excellent biomarker of lipid peroxidation for aging studies (Domenico Fusco1 Giuseppe Colloca1, Clinical Interventions in Aging 2007:2(3) 377–387) have shown that chronic vitamin C treatment is able to decrease high levels of isoprostanes in animal models. Ascorbic acid combined to α-tocopherol is particularly effective in inhibiting oxidation (Niki et al 1995). Vitamin C reduces α-tocopheroxyl radicals rapidly in membranes and LDL to regenerate α-tocopherol and possibly inhibits α-tocopheroxyl radical mediated propagation. Vitamin E is a lipid-soluble vitamin found in cell membranes and circulating lipoproteins. It protects against oxidative damage by acting directly with a variety of oxygen radicals. Its antioxidant function is strongly supported by regeneration 380 Clinical Interventions in aging 2007:2(3) Fusco et al promoted by vitamin C (Maxwell 1995). Vitamin E is thought to have a role in the prevention of atherosclerosis through inhibition of oxidative modifications of LDLs (Steinberg 1997).

Table 1: Types of Antioxidants

Endogenous Antioxidants	**Exogenous Antioxidants**
Enzymetics Catalase Superroxide dismutase Glutathione Glutamyl transe peptidase **Non Enzymetics** Uric acid Ubiquinone Tocopherol Retinol Glutayhione Melatonin Nuclear factor erythroid 2-related factor 2 (NRF2)	**Mineral Elements** Selenium Zinc Manganese Copper **Nutritional** Carotenoids Vitamin C Vitamin E Phytochemicals (Plant origin) **Supplementations** Beta Carotene, Co-enzyme Q-10 Lipoicacid, Glutathione Phytoestrogen, Polyphenols

5. Antioxidant Foods and Nutraceuticals

Currently, the beneficial effects of many foodstuffs and beverages for human health are thought to be used due to their antioxidant activities. Many research studies shown that antioxidant and antiradical capacities of many natural and industrial products that we consume as food and the compounds they contain and the methods developed for these studies have been continuing from the past to the present. As a result many studies, it has been found that many fruits and vegetables contain Phytochemicals such as flavonoids, phenolic acids and carotenoids. It is suggested that a diet rich in antioxidants will be beneficial for human health and therefore focuses on determining the antioxidant capacity of natural products (Alarcon and Deicona 2013; Gulcin 2012)

Due to the antioxidant activity of fruits and vegetables, antioxidants can be used in many fields such as food industry, packaging technology, pharmacology and cosmetics. Khanam et al. in their study published (2012).

Base on variety of vegetables and fruits and time of harvesting, growth and development of plants the capacity and concentration of antioxidant are varied.

Table 2, Use of natural antioxidant compounds in foods and their effects on health

Compounds	Usage in foods	Impact on health	References
b-carotene that	Carotenoids are the phytonutrients impart a distinctive yellow, orange, and red color to various fruits and vegetables	It has a potent antioxidant capacity and offers an array of health benefits such as lowering the risk of heart diseases and certain types of cancers, enhancing the immune system, and protection from age- related macular degeneration the leading cause of irreversible blindness among adults	Gul et al. (2015)
Phenolic compounds	The biological activity of green tea also promotes a protective effect by antioxidant mechanisms in biological and food systems, preventing the oxidative damage by acting over either precursors or reactive species	The bioactivity exerted by these compounds has been associated with reduced risk of severe illnesses such as cancer, cardiovascular and neurodegenerative diseases	Luksiene et al. (2013)
Phenolic compounds	Marine algae in the form of powder or extract, food products and nutritional and textural properties can be improved	Foods enriched with seaweed and seaweed extracts have positive effects on different lifestyle diseases such as obesity, dyslipidemia, hypertension and diabetes	Roohinejad (2016)
Phenolic compounds, flavonoids, carotenoids, pectin	Pectin extracted from Citrus peels is used in a wide range of food industrial process as gelling agent, including the manufacturing of jam, jellies and as thickener, texturizer, emulsifier and stabilizer in diary products. Citrus lemon is used in the development of functional foods	This compouns help prevent cancer, cardiovascular, coronary heart disease, oxidative damage, gastrointestinal diseases and diabetes	Gonza´lez-Molina et al. (2010), Reddy et al. (2003), Lin et al. (2007), Miyake et al. (2006), Miyake et al. (2007), Chen et al. (2003), Riccioni et al. (2007), Mertens-Talcott et al. (2007), Parija and Das (2003), Kurowska and Manthey (2004), Tsujita et al. (2003), Kim et al. (2003), Pirman et al. (2007), Barter (2005), Takahashi et al. (2003), Barter (2005) and Barter et al. (2005)

6. Antioxidant and Herbeceuticals

Many herbs are considered as having powerful Antioxidant properties, many leafy vegetables, fruits, roots, flowers, stem, bark of plant are having antioxidant property and its vary from plant to plant and herbs to herbs and herb`s parts to part. The antioxidant properties of herbs is determined to their chemical constituents are called Phytochemicals. There are number of herbs which contain antioxidant properties are as follows.

1. Emblica officinalis linn (Amla)

- Emblica officinalis linn is one of the most potent antioxidant. It is a major herb used in well-known rejuvenative herbal preparations.
- It is said that Emblica officinalis linn can bring back youth and grace to an ageing body and provide renewed vitality in the young.
- The fruit is reputed to have the highest content of vitamin C and is being considered as a good replacement for vitamin C than ascorbic acid. It`s Juice contain 20 times more vitamin C than orange juice. Studies indicate that the naturally occurring vitamin C is easier for the body to absorb than synthetic vitamin-C. It has also been found that vitamin C accounts for approximately 45-70% of the antioxidant activity in Amla.
- The extract of Emblica officinalis linn has been found to improve glucose metabolism in diabetes. Treatment with extract of Emblica officinalis linn brought about effective normalization of blood sugar levels.
- Administration of the extract of Emlica officinalis linn significantly reduced various oxidative stress indices commonly seen in diabetes [6,7].
- Emblica officinalis linn is also effective in reducing triglyceride and cholesterol levels and also protected the heart against injury from free radicals [8,9]. (Aysha Raza1 and Tabassum, Acta Scientific Women's Health (ISSN: 2582-3205): 6., 1: 2024)

2. Withania Somnifera (Asgandh / Ashwaganda)

- Withania Somnifera possess immune-modulatory anti-inflammatory, anti-tumor, antioxidant and anticancer properties.
- Many pharmacologically and medicinally important phytochemicals of Withania somnifera such as Withaferins, sitoindosides and various alkaloids protect the cells from oxidative damage and disease.
- The administration of extract of Withania Somnifera significantly reduced the lung tumor nodule formation and also reduced leucopenia induced by cyclophosphamide treated experimental animals, indicating its usefulness in cancer therapy.
- Withania increase the WBC count, reduce leucopenia and also increased bone marrow cellularity.

(Aysha Raza1 and Tabassum, Acta Scientific Women's Health (ISSN: 2582-3205): 6., 1: 2024)

3. Camellia sinensis (Tea)

- Tea infusion is characterized by a high content of flavonoids which are a large group of phenolic products of plant metabolism with a variety of phenolic structures that have unique biological properties and may be responsible for many of the health benefits attributed to tea.
- Many in vitro studies show that the flavonoids present in tea have strong antioxidant property and may therefore protect cells and tissues against free oxygen radicals.
- Tea is an important source of flavonoids in the diet with levels approaching 200 mg/cup for a typical infuses of black tea.
- The flavonoids found in green and black tea are very effective antioxidants both in vitro and vivo.
- The uptake of tea flavonoids has been studied extensively as well as the changes in antioxidant capacity of plasma after tea consumption and it was shown that consumption of tea reduced oxidative damage in the body.

(Aysha Raza1 and Tabassum, Acta Scientific Women's Health (ISSN: 2582-3205): 6., 1: 2024)

4. Zingiber officinalis Linn (Zanjabeel / Ginger)

- Ginger tea has long been an herbal remedy for nausea, coughs and asthma, related to allergy or inflammation; soft drink ginger is still remains a popular beverage for the relief of stomach upset.
- Externally, Ginger is a rubefacient, and has been relieving headache and toothache. Due to anti-inflammatory activity is that of the typical non-steroidal anti-inflammatory drug.
- Ginger reduce blood platelet “clumping,” and it inhibit the fatty acid oxygenases from platelets, thus decreasing the clumping of these blood cell components.
- In one study, Danish women between the ages of 25 to 65 years consumed either 70 grams raw onion or 5 grams raw ginger daily for a period of one week and measured thromboxane production. It discovered that ginger reduced thromboxane production by almost 60% than onion. In a series of experiments with rats discovered that extracts of Ginger preparations inhibited gastric lesions by up to 97%. Because it contain effective

constituents such as zingiberene, the main terpenoid and 6-gingerol, the pungent principle.

(Aysha Raza1 and Tabassum, Acta Scientific Women's Health (ISSN: 2582-3205): 6., 1: 2024)

5. Glycyrrhiza glabra Linn (Aslasoos)

- The pharmacological effects of Licorice rhizomes and roots are practically attributed to the presence of a triterpene saponin called glycyrrhizin, which is about fifty times sweeter than sugar, and has a powerful cortisone-like effect.
- Glycyrrhetic acid (G.A.) is extensively used as anti-inflammatory in peptic ulcer. It concluded that G.A. may be preferred instead of cortisone, because it is safe, especially when prolonged treatment is required.
- Licorice in very large amounts can promote hypokalemia and hypertension. For these reasons people with heart problems and high blood pressure are advised to avoid consuming large quantities of Licorice or its components.

(Aysha Raza1 and Tabassum, Acta Scientific Women's Health (ISSN: 2582-3205): 6., 1: 2024)

6. Curcuma longa Linn (Zardchob / Turmeric)

- Turmeric is the main ingredient in curry and is also source of herbal medicines.
- It's a powerful anti-cancer and an anti-inflammatory medicine.
- Currently, Turmeric is used in India to treat anorexia, liver disorders, cough, diabetic wounds, rheumatism, and sinusitis.
- In one study, Turmeric extract which contains an active chemical called Curcumin is a potent anti-cancer agent was tested for its anti-carcinogenic and anti-mutagenic properties. Laboratory experiments was found that this ancient spice reduced the size of the tumors in mice.
- Curcumin has three main mechanisms of action: 1) antioxidant activity; 2) lipoxygenase inhibitor; and 3) cycloxygenase inhibition. By inhibiting the associated biochemical pathways, inflammation is curtailed.

- Modern science thus confirms that the fresh juice from the rhizome will reduce swelling in recent bruises, wounds and insect bites; and that the dried powdered root kills parasites, relieves head ache and cold.

(Aysha Raza1 and Tabassum, Acta Scientific Women's Health (ISSN: 2582-3205): 6., 1: 2024)

7. Ficus carica linn (Anjeer)

- Ficus carica leaves in addition to their anti-diabetic properties; it has strong antioxidant and anti-inflammatory properties also.
- In a clinical trial conducted for its anti-inflammatory and antioxidant activity "F. Carica" leaves. The study validated that the antioxidant effect of fig leaves is likely due to the presence of steroids and flavonoids and the anti-inflammatory activity could be due to free radical scavenging activity [30].
- Dried fruits have a greater nutrient density, greater fiber content and significantly greater phenol antioxidant content compared to fresh fruits. The quality of the antioxidants in the processed dried fruit is the same as in the corresponding fresh fruit. Therefore, more dried fruits should be recommended to be added to the diet.

(Aysha Raza1 and Tabassum, Acta Scientific Women's Health (ISSN: 2582-3205): 6., 1: 2024)

8. Prunus amygdalus (Almond)

Almonds are high in antioxidants, vitamin E, protein, and fiber. Almonds may have health benefits, including supporting heart health and reducing blood pressure, among others. Almonds are among the world's most popular tree nuts. They are highly nutritious and rich in healthy fats, antioxidants, vitamins, and minerals. Here are 9 health benefits of almonds.

8.1). Almonds deliver a massive amount of nutrients
8.2). Almonds are loaded with antioxidants
8.3). Almonds are high in vitamin E
8.4). Almonds can assist with blood sugar control
8.5). Magnesium also benefits blood pressure levels
8.6). Almonds can lower cholesterol levels
8.7). Almonds prevent harmful oxidation of LDL cholesterol
8.8). Eating almonds reduces hunger
8.9). Almonds may be effective for weight loss
https://www.healthline.com/nutrition/9-proven-benefits-of-almonds on 18.12.2024

9. Juglans regia (Walnut)

- Walnuts are a great source of alpha-linolenic acid (ALA), an omega-3 fatty acid that is important for reducing inflammation. In fact, it is the only nut significantly high in these omega-3 fatty acids.

Their anti-inflammatory compounds may reduce the risk of heart disease.

- 4 health benefits of Walnut

9.1). Heart health
9.2). Brain health
9.3). Gut health
9.4). Cancer prevention

https:// health.ucdavis.edu>blog>good-food>2024.02.08, seen 2024.12.18

10. Honey

- Honey is a natural product made by honeybees (Apis mellifera) which have highly variable sensorial and physicochemical characteristics.
- Different honey types have diverse phenolic content and consequently different antioxidant activity. In addition, processing, handling and storage of honey may influence its composition. (Blasa., et al. "Antioxidant activity of Honey". Journal of Pharmcology (2007).

7. Conclusion

According to oxidative damage theory of aging, antioxidants should slow down aging and prolong lifespan and healthspan. There is a large body of evidence connecting the effects of oxidative stress on human body resulting in the development of a number of diseases. However, various clinical studies on the role of antioxidants and prevention of numerous health related conditions have been demonstrated. The relationship between antioxidants and longevity is complex. While epidemiological studies suggest that a diet rich in antioxidants from fruits, vegetables and nuts is associated with a reduced risk of chronic diseases and a potentially longer lifespan also some herbal origin of drugs do major play to maintain healthy lifespan.

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Conflict of Interests

The authors declare that there is no conflict of interests Regarding the publication of this paper

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