

Natural-Antioxidants, Bioactive Components and Nutraceuticals as Therapeutic Intermediaries - A Review

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Abstract

'Food as medicine' has always been an intriguing subject of R&D and innovation. More so, during these challenging times of coronavirus pandemic, the medicine world and its various streams are exploring the efficacy of several food condiments and ingredients laden with natural antioxidants, bioactive components and nutraceuticals as immunity boosters and antivirals. The advent of modern bio-separation techniques and technologies has made it easier to screen, identify, quantify, isolate and formulate the natural antioxidants, bioactive components and nutraceuticals of various food condiments and ingredients as functional and therapeutic intermediaries for several ailments and disorders of human body. This review article will briefly discuss about few such food condiments and ingredients which have been scientifically established to express progressive outcomes against several disruptive lifestyle based diseases.

Keywords: Natural - Antioxidants; Bioactive Components; Nutraceuticals; Therapeutic Intermediaries

Introduction

There has been a great deal of buzz over natural antioxidants, bioactive components and nutraceuticals resulting in them becoming the key words in the nutrition and food-pharmaceutical world for the past couple of decades. Consequently, many big and small nutrition and pharmaceutical business houses worth their salt have launched numerous anti-oxidant, bioactive and nutraceutical products but 'Are we missing the wood for the trees?'

When we talk of natural antioxidants we need not to think of some magical powders with herbal or natural written all over it. This meant that a natural antioxidant is actually natural only till it is present in its original natural form within the confines of its natural carrier. The moment we separate out a natural antioxidant from its pristine Au naturel habitat, it is no more a pure natural but becomes a pseudo-natural derived synthetically through chemical or physical means [1-14,20].

Synthetic antioxidants generally added to processed foods and beverages do not deliver the desired health benefits intended for the consumers. This is because of the fact that synthetic antioxidants do not efficiently absorb and metabolize in the body and the major proportion of these synthetic antioxidants get excreted out of the body. Natural antioxidants too, when consumed in isolated forms are found to be less effective in providing desired health benefits to consumers. It has been scientifically established through R&D that when natural antioxidants are consumed along with their natural carriers then only the desired health benefits are observed in an absolute manner

because body effectively absorb and metabolize such natural antioxidants confined in their natural carriers. Our body needs antioxidants only in nanograms to micrograms levels and for that we need to consume natural antioxidants only in milligrams level. Consumption of natural antioxidants in more than milligrams level may not provide desired benefits however it may show adverse effects because there is a good chance that consumption of excess levels of antioxidants may turn out to provide a pro-oxidant effect in the body [1-14,20].

Discussion

As the old adage goes, 'A picture is worth a thousand words', let us go through few illustrations to understand the root-cause of many chronic degenerative diseases and the role of natural antioxidants, bioactive components and nutraceuticals present in several foods, condiments and ingredients as functional and therapeutic intermediaries for several ailments and disorders of human body.

Figure 1 illustrates the role of Reactive Oxygen Species (ROS) in chronic degenerative diseases. ROS aka free radicals are malicious, unstable molecules in which an electron is absent in their outer-most shell. ROS or free radicals destroy healthy living cells by snatching electrons from them and damaging the healthy living cells in the process. ROS or free radicals are generated in the body due to various factors like toxicant exposure, inflammation, hyperglycemia, ischemia reperfusion injury, environmental pollution, toxins, pesticides, UV radiation, processed food and metabolic activities of the body. ROS or free radicals in turn result in DNA damage, impaired Ca²⁺ homeostasis, lipid peroxidation and protein oxidation at the cellular level and due to this mitochondrial dysfunction, decreased ATP synthesis and disrupted signaling occur at the cellular-mitochondrial level which consequently give rise to acute/chronic degenerative diseases of brain, nervous system, pancreas, digestive system, liver, heart, kidney etc. Oxidative stress produced by these ROS or free radicals on the cellular level damages the DNA of healthy living cells and accelerates the ageing process, damages the body's natural immunity to fight against infections and thereby causes chronic degenerative illnesses like Alzheimer's disease, Parkinson disease, Huntington disease, Amyotrophic lateral sclerosis, Diabetes mellitus, Hepatic steatosis, Myocardial infarction, Kidney diseases, cancer etc [15].

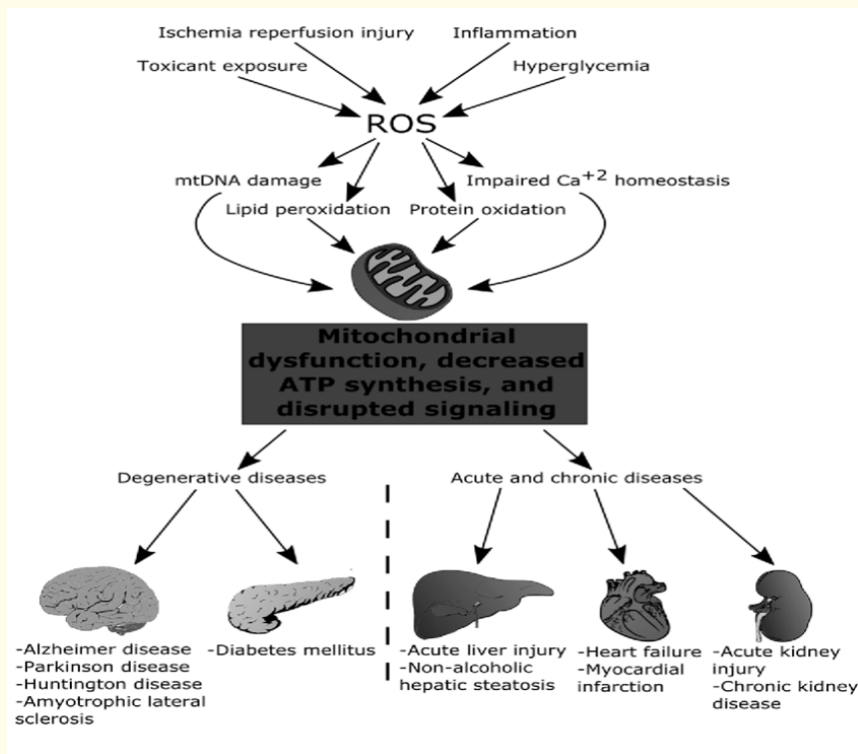


Figure 1: Role of reactive oxygen species (ROS) in chronic degenerative diseases [15].

Food nutraceuticals as therapeutics

Figure 2 and 3 illustrates the nutraceuticals present in green tea and various foods and condiments as therapeutics for chronic degenerative diseases and neurodegenerative diseases. Many food and nutrition experts recommend consumption of a large variety of antioxidants to provide protection to the body against ROS or free radicals. Antioxidants prevent ROS or free radicals from damaging the body at cellular levels. Tea is a rich source of dietary antioxidants as a single serving of tea has antioxidants equivalent to 10 servings of fruits or vegetables. Tea contains high concentrations of polyphenols (antioxidants), which are a class of phytochemicals called flavonoids. Flavonoids are a specific class of polyphenols present in citrus/juicy fruits, green/colored vegetables, tea, coffee, grape juice and red wine. Flavonoids possess strong antioxidant properties and protect cells and tissue against ROS or free radicals. Flavonoids also possess non-antioxidant properties like regulation of complex cell processes which can be associated with several health benefits. American Dietetic Association in 2005, identified tea as the most significant source of flavonoids [16,17].

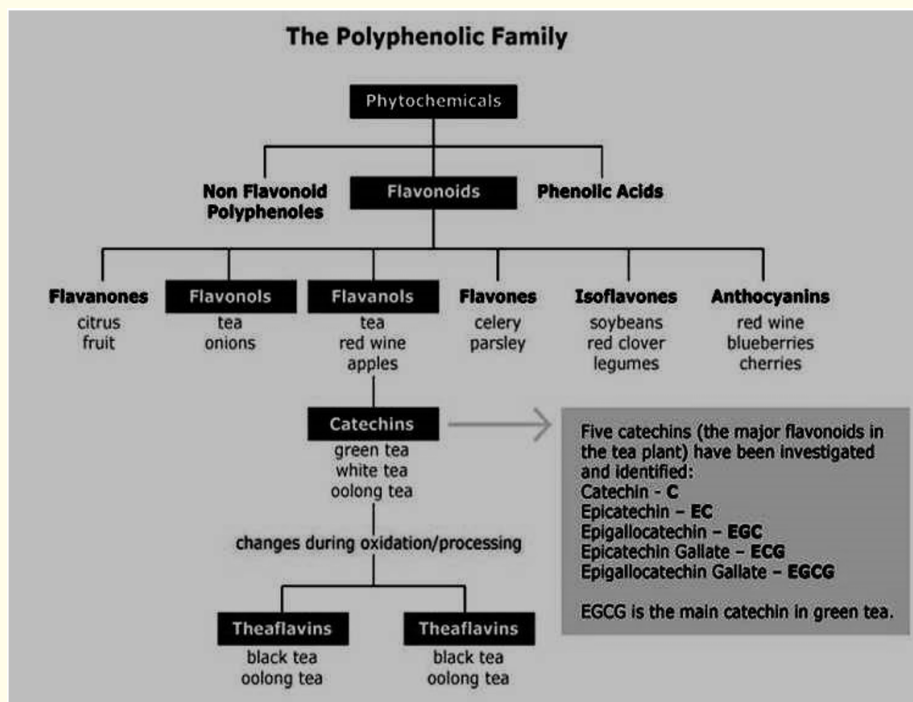


Figure 2: Types of polyphenols present in various foods [16].

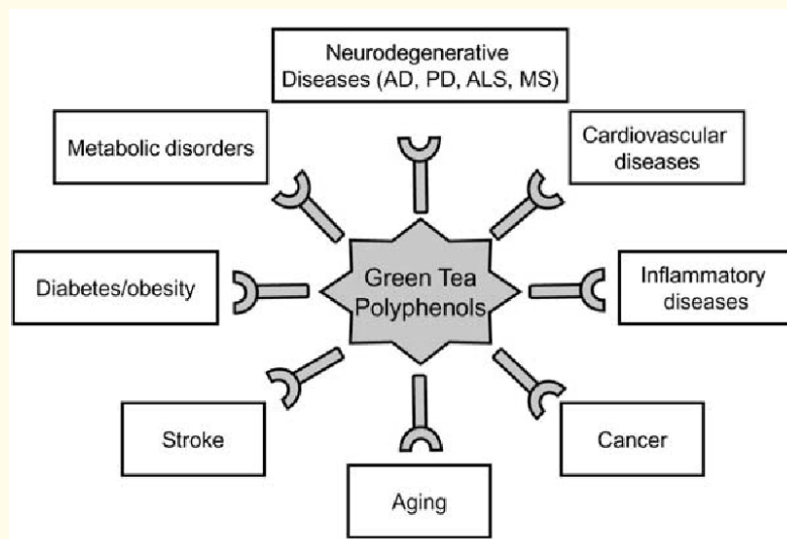


Figure 3: Green tea polyphenols as therapeutics for chronic degenerative diseases [17].

Figure 4 illustrates the nutraceuticals present in various foods as therapeutics for neuroprotection. Neurodegenerative diseases can be broadly classified based on their neuroprotective properties such as: Anti-oxidation, Anti-apoptosis, Mitochondrial homeostasis, Iron chelation, Cell signaling modulation and Anti-inflammation. Various nutraceuticals and polyphenols like tea and coffee flavonoids, vitamin C, vitamin D₃, B-vitamins, resveratrol, co-enzyme Q₁₀, creatine, ginseng, omega-3 fatty acids etc. present in green tea, citrus fruits, coffee, holy basil, eucalyptus, soya, peanuts, meat and dairy, red wine, dark chocolate, red/black grapes, green leafy vegetables, fish oil, spices, condiments etc. due to their multiple properties and functions via numerous pathways provide neuroprotection and prevent Parkinson’s disease, Alzheimer’s disease, Huntington disease, amyotrophic lateral sclerosis etc [18].

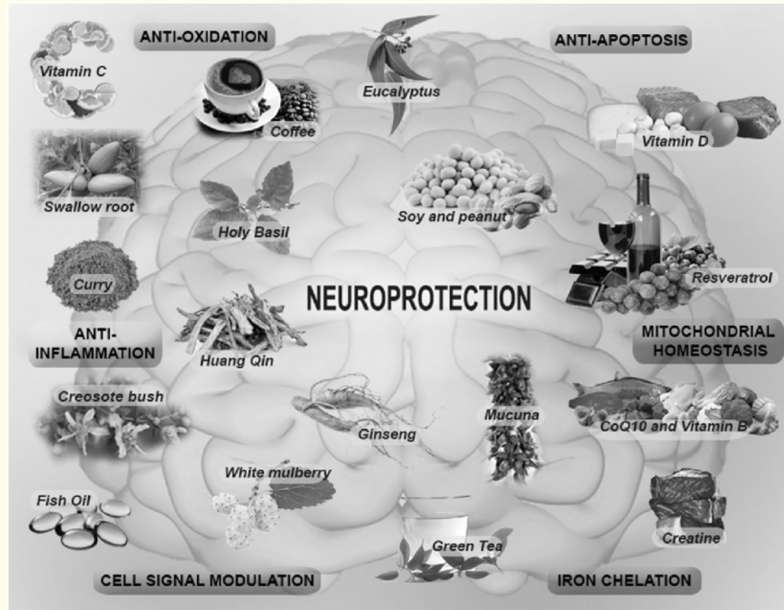


Figure 4: Nutraceuticals in various foods as therapeutics for neuroprotection [18].

Figure 5 illustrates the nutraceuticals present in olive oil i.e. biophenols like hydroxytyrosol, tyrosol, elanoleic acid, oleuropein, ligstroside, flavonoids, phenolic acids and monounsaturated fatty acids (MUFA) like oleic acid, palmitoleic acid and polyunsaturated fatty acids (PUFA) like linoleic acid and linolenic acid. These nutraceuticals present in olive oil exhibit antioxidant, anti-inflammatory and anabolic effects due to which oxidative stress decreases, lipid profile and endothelial vascular activity improves, inflammation decreases, mitochondrial activity improves, immunity enhances, strength improves, fat metabolism improves and energy expenditure is enhanced. As a result of this, diabetic condition of patients can be greatly improved [19].

Nutraceuticals of various edible vegetable oils as therapeutics

Virgin Sesame oil uniquely contains about 7000 - 8000 ppm of sesamin, a natural antioxidant that has been scientifically established to have a hypoglycemic anti-diabetic effect. Physically refined Rice bran oil uniquely contains about 10000 ppm of oryzanol, a natural antioxidant that has been scientifically established to have a hypocholesterolemic effect and promote heart health. Red palm oil contains about 5000 ppm of beta-carotene, a precursor of vitamin-A which is essential for eye health. Raw Niger seed oil being the richest plant source contains about 1500 ppm of phylloquinone (vitamin K₁) that has been scientifically established to promote bone health and also an important co-factor for blood-clotting. Both, corn oil and wheat germ oil have been established as the richest (1000 - 1500 ppm) plant

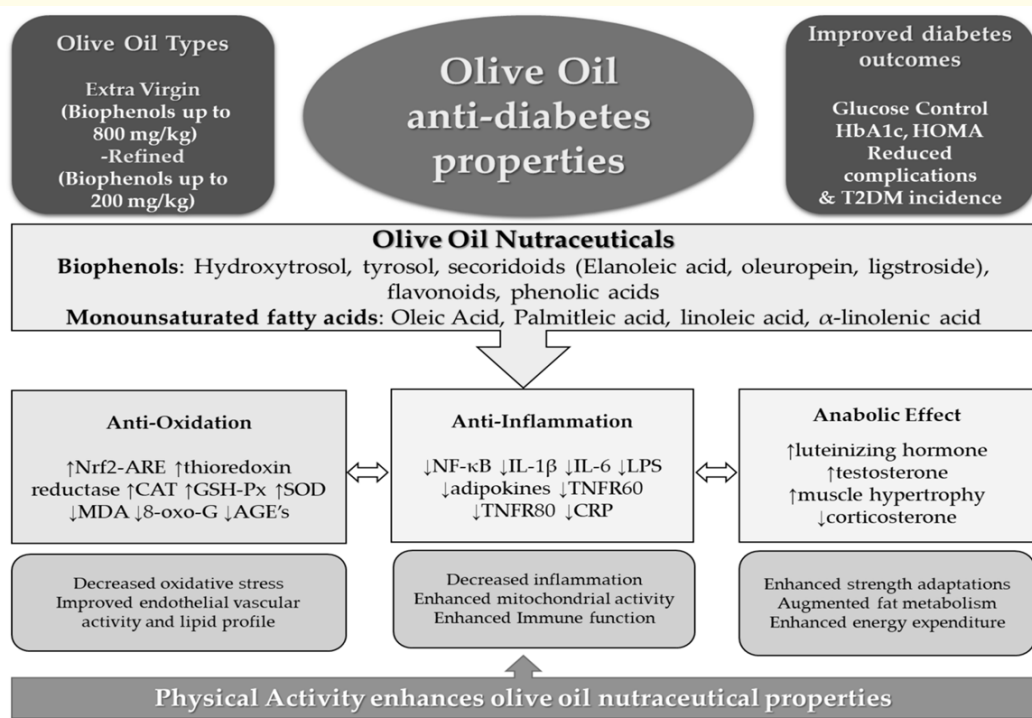


Figure 5: Nutraceuticals of olive oil as therapeutics for diabetes [19].

sources of natural tocopherols (vitamin-E) that scavenge free radicals like reactive oxygen species (ROS) and reactive nitrogen species (RNS). Virgin Olive oil contains natural polyphenols (1000 ppm) like chlorogenic acid that have free anti-inflammatory (pain reducing) effect. Apart from the above natural antioxidants, sesame oil is a good source of gamma-tocopherol (400 - 500 ppm); rice bran oil is a good source of tocotrienols (250-300 ppm), squalene (100 ppm), tocopherols (200 ppm) and phytosterols (8000 ppm); red palm oil is a good source of tocotrienols (400 ppm), tocopherols (400 ppm) and phytosterols (800 ppm); niger seed oil is a good source of tocopherols (200 ppm), phytosterols (1300 ppm) and polyphenols (250 ppm) [1-14,20].

Nutraceuticals of vegetables as therapeutics

The beverage industry can also utilize natural antioxidants like lycopene and ascorbic acid present in tomatoes and amla (Indian gooseberry) respectively. As it is known, lycopene is arguably the strongest natural antioxidant present abundantly in tomatoes, red fruits, watermelons etc. Lycopene has eleven conjugated double bonds which are attributed for its deep red color and antioxidant activity. Due to its strong color and non-toxicity, lycopene is a useful and healthy natural food coloring agent (registered as E160d) and has been approved for usage by USFDA, FSANZ and the EU council [1-14,20].

Conclusion

Now, since the role of natural - antioxidants, bioactive components and nutraceuticals as therapeutic intermediaries has been understood, let's have a look at those natural - antioxidants, bioactive components and nutraceuticals in their true and pure natural forms that can be utilized to enrich processed foods and beverages. The ready-to-eat (RTE) foods, gravies, curries, sauces, bakery foods, snack foods, pickles, frozen MRE (meals ready to eat) foods, frozen Indian curries etc. can be enriched with natural antioxidants by using sesame oil,

rice bran oil, red palm oil, niger seed oil, corn oil, wheat germ oil during the preparation processes. In simple words, include the above mentioned oils in the recipes of food preparations to an optimum extent keeping in view of the costing and viability of food products. If the above mentioned oils are used in the recipe formulations of food products preparation processes, natural antioxidants can be delivered to consumers directly in the most convenient and natural manner. This is nutritionally and economically far better than fortifying/enriching prepared food products with synthetic antioxidants during the later stages of processing. Tomato juice contains about 100 ppm of lycopene and can be directly used in appropriate proportions in mixed fruit juices, reddish and dark colored fruit juices and even in mixed fruit jams, jellies etc. Amla contains about 10000 ppm of ascorbic acid (vitamin C). Natural vitamin C extracts of amla can be added to non-citrus fruit juices to provide natural vitamin C directly to consumers. This is a better and effective protocol for delivery of natural antioxidants to consumers and is certainly better than adding synthetic vitamin C to fruit beverages during later stages of processing.

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