Tea Polyphenols as Antioxidants

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DOI: 10.5530/ax.2011.2.2

ANTIOXIDANTS - AN INSIGHT

Antioxidants are defined by the United States Food and Drug Administration (US FDA) as substances, which may be applied in preserving food by retarding deterioration, rancidity or discolouration due to oxidation. Antioxidants inhibit oxidative processes by reacting with free radicals, through metal chelation, and by scavenging singlet oxygen. Antioxidant compounds in food play an important role as a health-protecting factor. Scientific evidence suggests that antioxidants reduce risk for chronic diseases including cancer and heart disease. Primary sources of naturally occurring antioxidants are whole grains, fruits and vegetables. Plant sourced food antioxidants like vitamin C, vitamin E, carotenes, phenolic acids, phytate and phytoestrogens have been recognized as having the potential to reduce disease risk. Most of the antioxidant compounds in a typical diet are derived from plant sources and belong to various classes of compounds with a wide variety of physical and chemical properties. Some compounds, such as gallates, have strong antioxidant activity, while others, such as the mono-phenols are weak antioxidants. The main characteristic of an antioxidant is its ability to trap free radicals. Highly reactive free radicals and oxygen species are present in biological systems from a wide variety of sources. These free radicals may oxidize nucleic acids, proteins, lipids or DNA and can initiate degenerative disease. Antioxidant compounds like phenolic acids, polyphenols and flavonoids scavenge free radicals such as peroxide, hydroperoxide or lipid peroxyl and thus inhibit the oxidative mechanisms that lead to degenerative diseases. There are a number of clinical studies suggesting that the antioxidants in fruits, vegetables, tea and red wine are the main factors for the observed efficacy of these foods in reducing the incidence of chronic diseases including heart disease and some cancers[1,2,3].

TEA POLYPHENOLS

Phenolic compounds are secondary plant phenolics distributed widely in leaves, seeds, bark and flowers of plants, offering protection against ultraviolet rays and pathogens[4]. These phenolics are also important constituents in the human diet as they are found in fruits and vegetables, seeds as well as teas and wine. Extensive research has therefore been undertaken to evaluate their role in human health[5]. Phenolic secondary play an important role in the quality of plant–derived food, as they are relevant to appearance, taste and health promoting properties[6]. Flavonoids comprise the most group of plant polyphenols and contribute significantly to the flavour and colour of fruits and vegetables[7]. The beneficial health effects are attributed to their antioxidant and metal chelating abilities[8].Other beneficial biological activities of flavonoids include anti-bacterial and antiviral activity, anti-inflammatory, anti-angionic, analgesic, anti-allergic effects, hepato-protective, cytostatic, apoptotic, antimutagenic/anticancer, estrogenic and anti-estrogenic properties[9-12]. Phenolic compounds play an important role in lowering low-density lipoprotein (LDL) peroxidation and thereby aid in the prevention of atherosclerosis[13,14]. More than 500 different flavonoids have been described so far with the six major subclasses of flavonoids including the flavones (e.g apigenin, luteolin), flavonols (e.g quercitin, myricetin); flavanones (e.g naringen, hesperidin); catechins or flavanols (e.g epicatechin, gallocatechin); anthocyanidins (e.g cyaniding, pelargonidin), and isoflavones (e.g genistein, daizein). Most of the flavonoids present in plants are attached to sugars (glycosides) or they are found as aglycones[15].

The dried green tea leaves preserve the original constituents in tea leaves. The characteristic polyphenolic compounds in tea are known as catechins, which include (-)-epigallocatechin-3-gallate (EGCG),

(-)-epigallocatechin (EGC), (-)-epicatechin-3-gallate (ECG), and (-)-epicatechin (EC), with EGCG being the major catechin in tea. Polyphenolic structures are characterized by several hydroxyl groups on aromatic rings. Tea also contains other polyphenols in small quantities such as quercetin, kaempferol and myricetin, as well as the alkaloids caffeine and theobromine. A typical brewed green tea contains 240-320mg of catechins and 20-50 mg of caffeine[16]. Tea catechins and other tea polyphenols are efficient scavengers of free radicals. Several functional groups in their structures appear to be important in conferring their low reduction potentials. All catechins have two hydroxyl groups in ortho-position in the B ring, which participate in the electron delocalization. Both ECG and EGCG have three hydroxyl groups in the B-ring. In ECG and EGCG, the hydroxyl group at the 3 position in the C-ring is esterified with gallic acid, thus providing three more hydroxyl groups. The tri-hydroxyl groups in both the B-ring and the gallate moiety have been associated with increased anti-oxidant activity[17].

In future commentaries, we shall highlight more in depth comment on useful polyphenols used as antioxidants.

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