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Review

Tea consumption and disease correlations

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ABSTRACT

Tea is the most widely consumed beverage in the world next to water and is obtained from the leaves *Camellia sinensis*. In recent years, the potential health benefits and effect mechanisms of tea have attracted a lot of interest. The potential health benefits of tea have been attributed to its various phenolic compounds with unique biological properties found in tea. These phenolic compounds are especially catechins and their derivatives, which constitute at most 30% of the dry weight of the tea. Tea is a new and effective strategy for reducing the severity of neurological diseases and for protecting against obesity, cardiovascular disease, type 2 diabetes and certain types of cancer (ovaryum, lung, skin, breast, endometrial, prostate, bladder, oral and colorectal cancers).

Overall, the study that supports the health benefits of tea is increasing. But, the amounts of and the frequency of tea consumption that is associated with potential health benefits vary greatly from work to work and this situation creates difficulty in determining the optimal consumption amount and frequency that tea can exhibit health benefits. For this reason, we aimed to examine the health effect of the tea and how much consumption is to investigate whether it meets the claimed health benefits.

Within that frame, there is a need for more studies on the possible health effects of tea. While studying on that effect, the effects of various doses, forms (in synthetic or natural product matrix), exposure in different periods (short or long term) on health should be studied. However, currently the conducted studies are promising for tea is a bioactive component like polyphenol, theaflavins, thearubigins, caffeine and mineral. In addition, although the fact intake with diet proved to be reliable at the end of the conducted acute and chronic toxicity test is another positive part, safety of bioactive component in tea should be supported through further studies.

1. Introduction

The first documented sources of tea appeared in China in the third century CE (Munday, 2016), but archaeological studies indicate that the tea was first consumed in the early Palaeolithic period (Cooper, 2012). Besides its being the oldest drinks, tea has enormous medical, economic and cultural importance since ancient times (Xia et al., 2017). With the awareness that tea improves health and prevents some diseases, its consumption has been considered as a "health-promoting habit" and modern medical researchers have provided the scientific basis for this belief over time (Chen & Lin, 2015; Feng, Ng, Kua, Lee, & Preedy, 2015; Khan & Mukhtar, 2013; Venkateswara, Sirisha, & Chava, 2011). Because tea has antioxidant, thermogenic, anti-inflammatory, cholesterol-lowering, antimicrobial, neuroprotective, anti-hypertensive and anti-carcinogenic properties (Li & Zhu, 2016), its presence in daily human diet is significantly high (Qi et al., 2017). Studies have shown that tea has beneficial effects on many chronic diseases such as cancer, cardiovascular diseases, obesity, diabetes and neurological diseases (Heber et al., 2014; Lee, Su, Pasalich, & Binns, 2013; Mao et al., 2010; Miller et al., 2016; Tomata et al., 2016; b, Wang, Yang, Zhang, & Wu, 2014).

However, many topics like toxicological effects, doses, amounts, usage in the body, advantages and disadvantages, etc. of these active molecules need to be examined. For these reasons this article was reviewed to evaluate health effects of tea.

2. Tea and its composition

The tea plant has two main types, *Camellia sinensis* and *Camellia assamica*. *Camellia sinensis* is a long-lived and small-leaf plant that can withstand cold weather, while *Camellia assamica* is a short-lived, more sensitive and large-leaf plant that can grow easily in tropical and rainy regions (Üstün & Demirci, 2013). Tea is mainly produced from the leaves of plant Camellia sinensis and it is the most widely consumed beverage worldwide next to water (Tang, Li, Qiu, Zhou, & Ma, 2009b). There are four main types of tea: black tea, green tea, white tea and oolong tea (Butt et al., 2014; Vernarelli & Lambert, 2013). Worldwide,

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approximately 78% of total tea production account for black tea while 20% of total tea production account for green tea (Yuan, 2011). Although these main types of tea are produced from the same plant, they are obtained from different fermentation processes (Yajima, 2014). Green tea is non-fermented while oolong tea is semi-fermented and black tea is fully fermented (Chan, Soh, Tie, & Law, 2011). In addition degree of fermentation for white tea is approximately 10–20% (Kim, Kim, & Lee, 2012). These differences in the fermentation process lead to important differences in the final polyphenols balance (Matthews, 2010). For example; from white tea toward black tea, theaflavins and thearubigins increase while catechins decrease (Selena Ahmed, 2012). Unlike fermented and semi-fermented teas the major polyphenols of unfermented green tea belong to catechin family (Hintzpeter, Stapelfeld, Loerz, Martin, & Maser, 2014; Jówko, 2014) and these are (−)-epicatechin-3-gallate, (−)-epicatechin, (−)-epigallocatechin and (−)-epigallocatechin-3-gallate (EGCG) (Xiang et al., 2016). Furthermore, most of the chemical changes such as production of oxidized polyphenolic compounds such as theaflavins and thearubigins which are account for the sensory characteristics of black tea are occurred during the fermentation process of black tea (Samanta et al., 2015; Wang & Ho, 2009). Among all tea types, white tea is thought to be the oldest form of tea due to it is the least processed tea (Kim, Choi, & Park, 2015; Mao, 2013) and it contains gamma-amino butyric acid (GABA) and L-theanine (Malongane, McGaw, & Mudau, 2017). The polyphenols found in black and green tea are given in Fig. 1 (Lorenz, 2013; Yong Feng, 2006).

Thearubigins and theaflavins in black tea and catechins in green tea are the substances account for the physiological effects of tea (Lorenz, 2013) including inhibition of cancer cell proliferation, inflammation, platelet aggregation and anti-apoptotic proteins; regulation of glucose and lipid metabolism and DNA repair; stimulation immune function; modulation detoxification enzymes and anti-oxidant, anti-inflammatory and antimicrobial activity (Katiyar, Elmets, & Katiyar, 2007; Serafini, Del Rio, Yao, Bettuzzi, & Peluso, 2011; Tenore, Campiglia, Giannetti, & Novellino, 2015). The antioxidant activities of catechins depend on hydroxyl group at C-3 position in the basic structure or the higher degree of hydroxylation of the B ring (Tenore, Stiuso, Campiglia, & Novellino, 2013). Among green tea catechins, EGCG is the most abundant, most potent and most studied catechins as well as most powerful antioxidant for cancer chemoprevention (Chan et al., 2011; Du et al., 2012; Johnson, Bailey, & Mukhtar, 2010). In a study by Hajiaghaalipour, Kanthimathi, Sanusi, and Rajarajeswaran (2015), demonstrated that the antioxidant, anticancer and DNA protective effects of white tea (*C.sinensis)*. The high antioxidant activities correlated significantly to their phenolic content and white tea extracts showed potential as chemotherapeutic agents. They suggested that regular consumption of white tea could maintain good health and protect the body against colorectal cancer. Besides catechins, caffeine contributes to the stimulating properties of tea and theanine contributes to the relaxing properties of tea and both of these have synergistic physiological effects in developing mental alertness (Selena Ahmed, 2012).

3. Tea consumption and disease correlations

Tea consumption protects against the development of chronic diseases (Mao, 2013) and is associated with reduced risk of cardiovascular diseases, cancer, inflammation, obesity and type 2 diabetes (Gondoin, Grussu, Stewart, & McDougall, 2010). As a result of a study, it has been suggested that tea is safe and cheap drink and that its consumption should be supported due to potential health benefits (Lee et al., 2013).

3.1. Tea consumption and cancer

Tea polyphenols with chemo-preventive properties provide the protection against all stages of carcinogenesis by preventing inflammation and progression of tumor due to its antioxidant properties against free radicals and thus it initiates apoptosis and cell cycle arrest (Lee et al., 2013). Black tea polyphenols protect against different types of cancer through their ability to inhibit carcinogenic activating phase 1 enzymes, activate antioxidant and detoxifying enzymes, modulate xenobiotic-metabolizing enzymes, scavenge free radicals, protect against DNA damage, induce apoptosis and inhibit angiogenesis, cell proliferation, invasion and metastasis (Kumar, Pillare, & Maru, 2010; Nagini & Senthil Murugan, 2013). In addition, green tea polyphenols protect against different types of cancer by inhibition of anti-apoptotic protein expression, induction of pro-apoptotic protein expression, activation of caspase-3 and caspase-9, inhibition of cell proliferation, metastasis and angiogenesis and induction of cell cycle arrest and thus it inhibit uncontrolled cell proliferation, induce apoptosis and reduces the risk of cancer cell formation (Amin, Zhang, & Shin, 2013; Kumar &

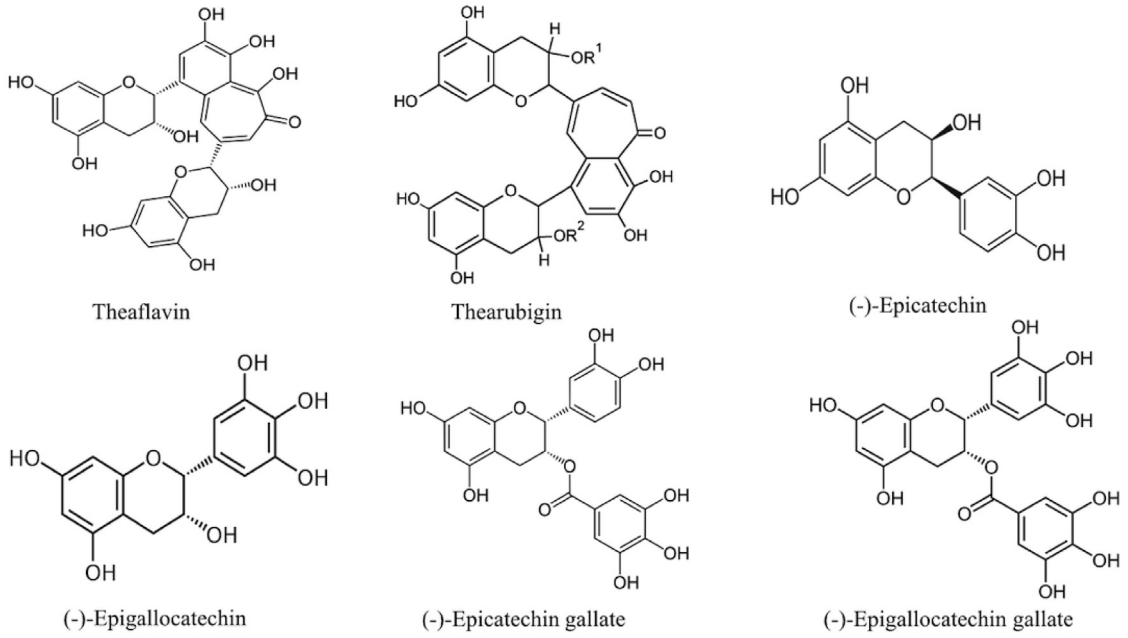

Fig. 1. The polyphenols found in black and green tea.