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Tea Types and Health Benefits

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Abstract: ***The infusion of the leaves of the Camellia sinensis plant is tea, this is not to be confused with herbal teas. All types of teas including white, green, oolong, black, and Pu-erh tea, are produced from the leaves of the Camellia sinensis plant. Different processing methods yield the various types of tea. Tea contains over 2000 components. Caffeine, flavonoids, fluoride, and theanine etc. are found as the main bioactive chemicals in tea. Green teas are especially rich in a group of flavonoids called flavan-3-ol monomers or catechins. More complex chemicals theaflavins and thearubigins which are derived from catechins have been reported in black tea. Health benefits of drinking tea is known since ancient times, now this belief is getting stronger day by day with growing researches in this field. Tea is found useful against various ailments like cardiovascular diseases, type 2 diabetesmelitus, cancers and in some cognitive diseases etc.***

Keywords: *Camellia sinensis*, caffeine, flavonoids, polyphenols, cardiovascular diseases

1. Introduction

Tea which is supposed to be an aborigin of China (about 2700bce) was considered as a medicinal beverage for millennia, but it became a daily drink about 3rd century ce and then its cultivation and processing started. Nowit is a very common and important beverage all over the world. People from 160 countries throughout the world are accustomed to tea drinking. It is an infusion of leaves of the plant *Camellia sinensis*.Aside from water, it is the most widely consumed and an appreciated beverage in the world because it is found to have capacity to reduce many chronic diseases and cheapest beverage next to water.Tea leaves are processed by different methods, which involve variable degrees of oxidation and result in different types of teaswhich include green, oolong, or black tea. Processing of tea is an art which decides the flavour of resultant tea.In 2014, Americans consumed 3.6 billion gallons of tea, of which 84% was black tea, 15% was green tea, and the remaining was white, oolong, and dark tea. Daily consumption of green tea is being recognized better. Herbal teas are infusions of herbs or plants other than *Camellia sinensis* and therefore are not discussed in this article.

Bioactive Compounds in Tea

Tea contains a number of bioactive ingradientslike caffeine and fluoride, butmost researches have focused on the potential health benefits of a class of compounds in tea known as flavonoids. In many cultures, tea is an important source of dietary flavonoids.Chemical composition of tea is quite complex**.** It contains over 2,000 components, which include polyphenolic compounds (flavonoids), alkaloids (caffeine, theophylline, theobromine), pigments (carotenoids and chlorophyll), lignans, proteins and amino acids (including L-theanine), carbohydrates, lipids, vitamins (vitamin C, vitamin E, riboflavin), enzymes(Poly phenol oxidase PPO and peroxidase, and various other minerals and some trace elements [1]. These bio active phyto-chemicals add flavor, aroma, astringency and taste to tea extract as well as these are responsible for its medicinal value and various health benefits.

On the basis of their chemical structures these flavonoids are divided into six subclasseswhich are flavan-3-ols, anthocyanidins, flavanones, flavonols, flavones, and isoflavones (Figure 1).Tea leaves contain a polyphenol oxidase (PPO) enzyme in separate compartments from flavan-3-ol monomers or catechins (Figure **2**,3).

During processing when tea leaves are broken or rolled cell compartmentalization is disrupted then PPO comes into contact with catechins which causes condensation of catechins resuting in formation of dimers and polymers known as theaflavins and thearubigins[2]respectively[Figure 3]. In tea industry this oxidation process is often described as fermentation. The oxidation process can be stopped by steaming, firing, or baking tea leaves which inactivates poly phenol oxidase.

Figure 1. Basic Structures of Flavonoid Subclasses

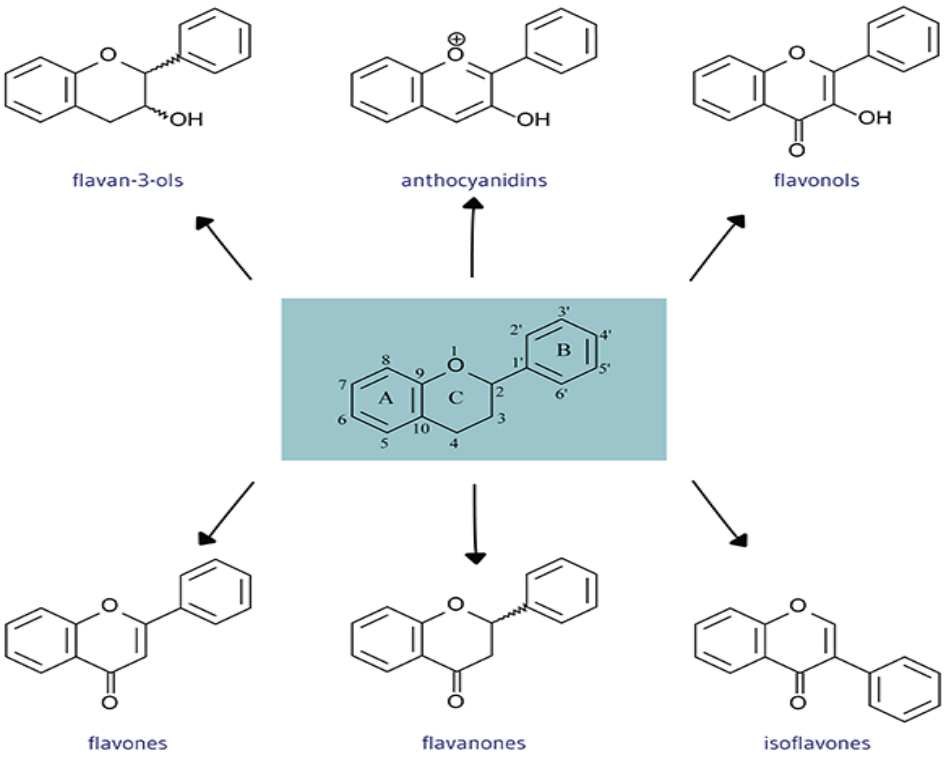
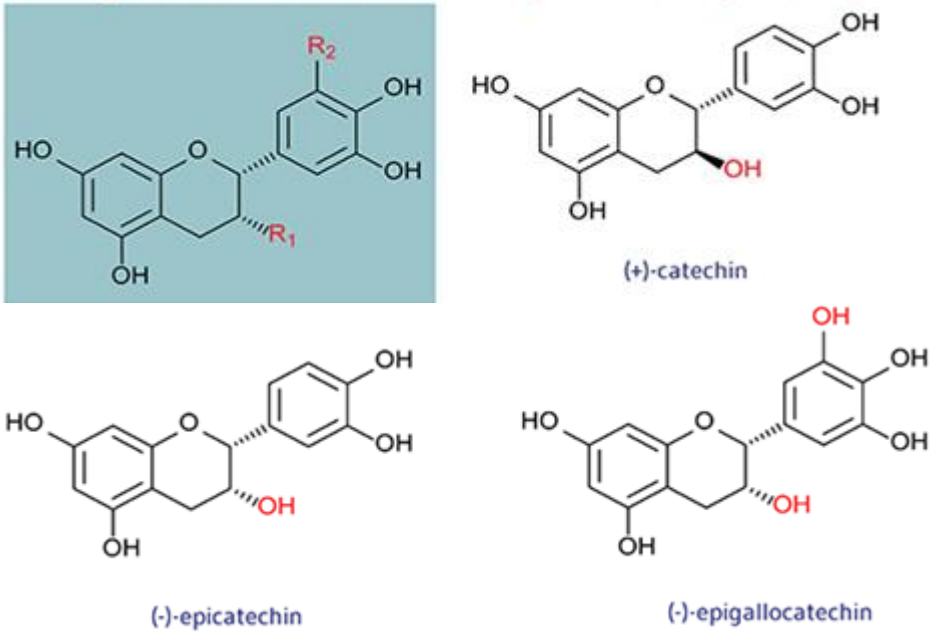


Figure 2. Chemical Structures of Principal Flavan-3-ols (Catechins) in Tea



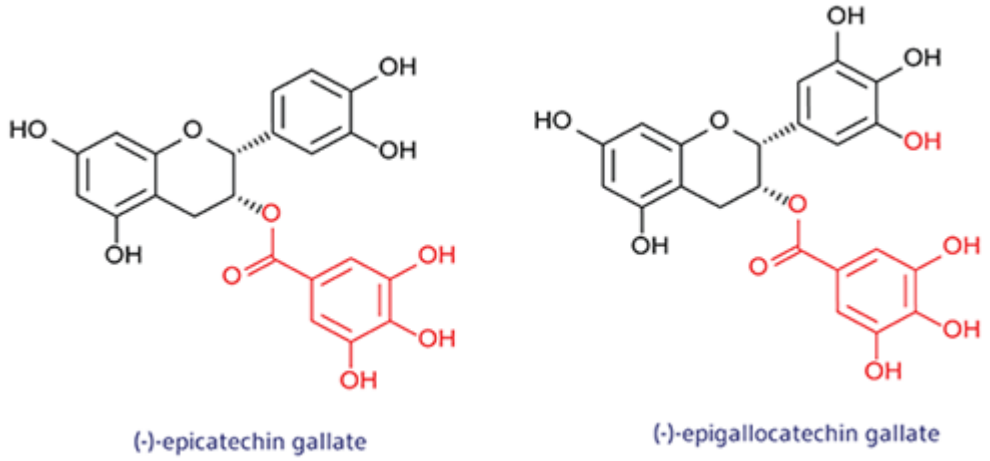
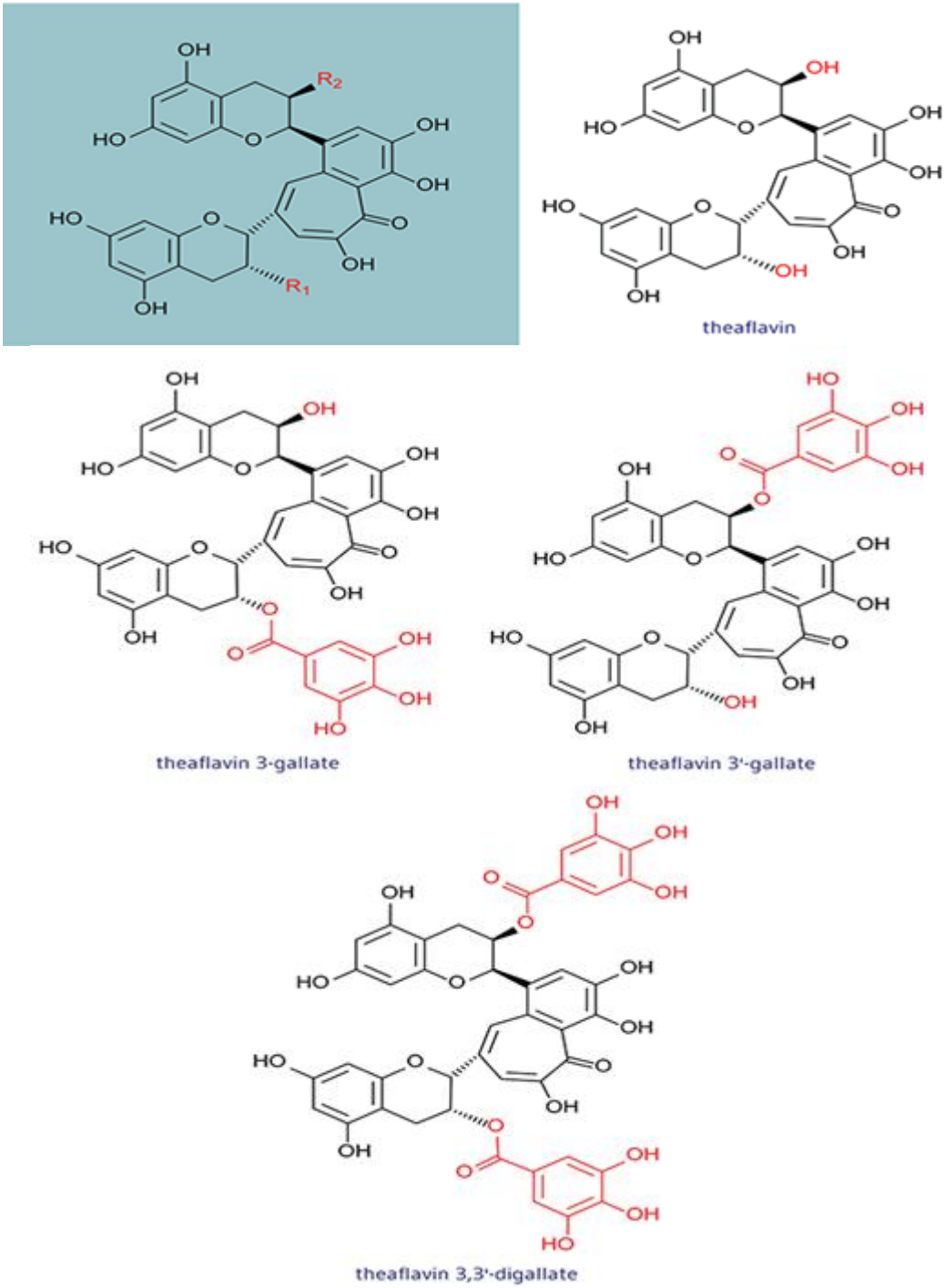


Figure 2

Figure 3. Chemical Structures of Some Theaflavins in Tea



Tea types:
The two prominent varieties of tea plants for cultivation are *Camellia sinensis var. sinensis* and *Camellia sinensis var. assamica*. The former is native of China and usually it is used for making white and green tea. The latter originates from Assam region of India, as well as regions of Southeast Asia and it is often the source of black teas, including pu-erh tea (a variety of fermented tea) traditionally produced in the Yunnan province of China.

The principal Camellia sinensis is main source of thousands of tea cultivars. All the different types of teas are produced by applying different types of processing methods on the leaves of tea plant *Camellia sinensis*. Fresh tea leaves are rich in polyphenolic compounds(flavonoids). On the basis of extent of oxidation they undergo during processing, teas are usually divided into five types.Different tea preparations depend on the applied withering method (the process of allowing the fresh leaves to dry) and the method used for deactivating process of PPO(1).

White tea is made from unopened buds and immature leaves, which are steamed to inactivate polyphenol oxidase and then dried. White tea retains the high concentrations of catechins present in its fresh tea leaves because of minimal oxidation.

Green tea is made from more mature tea leaves than white tea.Its tea leaves are withered prior to steaming, and then rolled and dried. Like white teas, green teas have high concentrations of catechins, but depending on its commercial source [3] and cultivar the total content and composition of catechins may vary.Among all tea types green tea is best studied for its chemopreventive and chemotherapeutic effects [4] Sometimes both green and white teas were found to have same amount of catechins but still they exhibited different antioxidant properties due to presence of other non-catechins antioxidants found in teas.

Oolong tea is prepared by bruisingtea leaves to allow the release of some of the polyphenol oxidase present in the leaves. Oolong tea requires oxidation to a greater extent than for white or green teas, but it takes less time than black teas, before they are heated and dried. As a result oolong tea contains catechin, theaflavin, and thearubigin levels generally in between those of green (unfermented) and white teas and black tea(completely oxidized)[5]

Black tea preparation requires maximum interaction between catechins and PPO. For this tea leaves are fully rolled or broken to maximize the interaction.The tea leaves are allowed to oxidize complete oxidation before drying so most black teas are found to have relatively low concentrtions of monomeric flavan-3-ols, like (-)-epigallocatechin gallate (EGCG), and rich in theaflavins (2%-6% of extracted solids) and thearubigins.

Pu-erh tea (pu'erh tea, pu'er tea, or Chinese black tea)
This tea isproduced from *assamica* variety of *Camellia sinensis* mostly in the Yunnan province of China from the larger leaves of the plant. It is made either by enzymatic oxidation or byfungus led fermentation process. enzymatic oxidation and fungus-led fermentation. For preparation of raw (aged) pu-erh tea, the initial process resembles that used to make green tea. The leaves are heated, dried, and then dampened and then pan-fired and compressed. After that the preparation is carefully stored in a controlled environment and left to age for decades. To produce ripened pu-erh tea, combined processes are used which include oxidation and fermentation by the fungus Aspergillus niger for several months.

Health benefits:
Since ancient times drinking tea is considered as a health promoting habit. This belief is strengthened by the scientific researches in this field[6] The benefits of drinking tea go far beyond refreshment. Many studies claim its various health benefits against many debilitating diseases like cardiovascular diseases(atherosclerosis and coronary heart diseases) and other metabolic health related diseases including anti-aging, anti-diabetic etc. Polyphenolic compounds which are found in tea, the catechins and theaflavins are found to be responsible for most physiological effects of tea.Some of its role against differentdiseasesare given here:

Cardiovascular disease: Different studies reveal that daily consumption of tea lowers the risk of cardiovascular diseases (CVD) like coronary heart disease and stroke in humans [7] [8]. It exhibited some properties which are beneficial for prevention against CVD like antioxidant, cholesterol-lowering, antihypertensive and anti-inflammatory properties.[9]

Hypertension: At present about 20% of adultpopulation is affected by high blood pressure worldwide.Many intervention studies have confirmed the beneficial effects of tea on high blood pressure.Tea and its secondary metabolites are found to be important in relaxing smooth muscle contraction, enhancing endothelial nitric oxide synthase activity, anti-vascular oxidative stress, reducing vascular inflammation and inhibiting renin activity. Exact mechanism of above reaction is yet to be elucidated [10].

Type 2 diabetes mellitus:It is found that tea consumption has been associated with reduced risk of developing type-2 diabetes mellitus[11],[12]. Though this involves complex mechanisms but it possibly involves a role of tea bioactive compounds in regulation of energy balance, lipid and glucose metabolism, insulin sensitivity, body composition, and/or body temperature.

Overweight and obesity: In a study it is found that regular consumption of green or pu-erh tea extracts reduced body weight and body mass index (BMI) in overweight people with metabolic syndrome.[13],[14].

Cancer: Consumption of tea was found to have promising results in prevention of cancers in animals but in humans current evidences do not support the role for tea consumption as preventive measure against most cancers.[15][16][17]

Bone health and osteoporosis: There is no clear evidences about its role against osteoporotic fractures and increased bone mineral density.It is still unclear whether tea

consumption is associated with increased bone mineraldensity and/or reduced risk of osteoporotic fractures [18], [19].

Dental health: In some researches it was found an inverse association between tea consumption and risk of tooth cavities and some studies reveal that toothpastes and mouth washes having green tea extract can also be helpful in reducing dental plaque and gum inflammation in patients. [20].

Kidney stones: Lower risk of kidney stones with the highest versus lowest level of tea intake has been reported [21]. Research is needed to assess the impact of oxalate content in tea with history of kidney stones.

COVID-19 Some researchers from Indian Institute of Science Education and Research (IISER), Bhopal identified that polyphenols which include catechins present in green tea are useful for COVID -19 treatment and comorbidities.[22].

Mood is an emotional state of mind which comprisestates like relaxation, alertness, affection, relief from depression, different feelings of guilt, failure etc,[23].

Dipression is a mood disorder. Some cohort study revealed that less dipressive symptoms were found in participants who were having higher intake of tea comparative to participants with less intake.[24],[25].

Cognitive function
It includes attention, executive function, memory, calculating power, reflex actions, processing speed etc, These function decline with growing age.There are evidences from some observational and data based studies which shows role of tea consumption in prevention of cognitive decline[26]It is required that Clinical studies must be done to assess whether tea or its bioactive constituents could reduce or prevent cognitive decline and/or improve cognitive dysfunction in individuals. [27]

Parkinson's disease
It is a neurodegenerative disease. Worldwide about 0.5% - 4% older people above 65 yrs. get affected by PD, in which selective death of brain cells-dopaminergic cells occurs. A retrospective study revealed that onset of symptoms was delayed by many years in those who were drinking more than 3 cups tea per day compared to non drinkers.[28],[29]. It has been reported in certain clinical trials that use of green tea extracts causes gastrointestinal disorders and liver toxicity and tea consumption was found to have potential interference with some medications which include anticoagulants, some cardiovascular drugs, warfarin.

Drug interactions
Excessive green tea consumption reduces the therapeutic effects of certain medications like warfarin (Coumadin, Jantoven).A number of drugs can impair the metabolism of caffeine, increasing the potential for adverse effects from caffeine. Tea chemicals are found to have some interactions with nutrients likeflavonoids in tea can bind non heme iron(principal form of iron in plants, dairy products etc.) and inhibits it's intestinal absorption. It has been found that about70% decreased absorption of nonheme iron occurs by consumption of one cup of tea with a meal. Flavonoids can also inhibit heme iron absorption in intestine. Humans with poor iron status should not consumetea with food or iron supplements. Healthy individuals having no risk of iron deficiency need not to restrict consumption of tea.

2. Conclusion

Tea is most consumed and popular beverage worldwide, consumed by about 2/3 population of world. It is cheapest next to water. This article describes key constituents of tea and many health benefits associated with drinking different types of teas. It is found to be a useful chemopreventive beverage for many chronic diseases like CVD, diabetes, Parkinson's diseases, hypertension, neurodegenerative and cognitive diseases and also regarded as an anti-aging, energetic drink. Now a days green tea supplemented various products like cosmetics, tooth pastes etc. are also in the market showing its popularity.Although many studies have been done and polyphenolic compounds are found to be responsible for most physiological effects of tea yet some well controlled clinical trials on large scale are necessary in this field so that proper recommendations of its health benefits could be made for human population of different age group.

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