Morphology, Manufacturing, Types, Composition and Medicinal Properties of Tea (Camellia sinensis)

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Abstract
Fascinating aroma, attractive taste, and many health effects of tea, make it a popular beverage worldwide. All Tea types belong to the same family of the camellias. Applying various manufacturing processes on fresh leaves of Camellia sinensis produces white, green, black, yellow or oolong tea, which their brewers differ in color and taste.

Polyphenols, caffeine and theanine are the main bioactive ingredients in Camellia sinensis. Polyphenols in tea consist mainly of catechins, flavonol-β-glycosides, flavonol-α-glycosides, proanthocyanidins. In addition black tea contains theaflavins and thearubigins which arising from the catechins during the fermentation. Many of the health benefits of tea may depend on the biological activities of the considerable concentrations of antioxidants in particular the polyphenols in tea, make its brewer a good candidate to stop the development of some serious diseases such as diabetes, obesity, cavity and cardiovascular diseases. Tea also enhances the immune system and inhibits several kinds of cancers, such as stomach, colon, pancreatic, liver, bladder, lung, and breast cancers. On the other hand, toxic contamination by heavy metals and flavonoids can happen depending on the dose intake of tea.

Keywords: Tea; Types; Production; Polyphenols; Health benefits

Introduction
A Japanese cultural philosopher, Kakuzo Okakura (1862- 1913), styled tea (Camellia sinensis) as a medicine then as a drink. Tea has been considered as an necessary daily element for life and as a ritual element in ancient China and Japan, respectively. The good flavor, attractive aroma and taste, besides its health-promoting effects and being the main caffeine-drink worldwide makes it one of the most common beverages in the world. In ancient China, the effective pharmaceutical activity of tea was known and thus its brewer was used as a medicinal drink.

Historically, tea has important roles not only as ancient health therapy, but also as subject of the visual and literary arts. Tea was painted, drawn and figured on textiles and ceramics. Its shape, color, perfection and social interactions were described in many Odes [1,2].

Tea Plant: Origin, Morphological Characters, Grow and Plucking

Tea, as a plant, belongs to the family of the camellias and it has two main kinds:

Camellia sinensis belongs to China, Tibet and Japan. It is not a big tree but rather a bush. It is small with 1–2 m tall (Figure 1). It has many stems. Leaves are leathery with matt surfaces. Because leaves are thick and hard, it is difficult to recognize the veins in the lamina. The blade of the leaf is elliptic and it has an obtuse end. The base is straight. The edge has teeth. When the leaves are young, they are smooth with some fine hairs on the bottom, but when they grow older the hairs lessen and even disappear. The 2 inch leaves are resistant to very cold temperatures and garnet-brown through ox-blood to purple in color [1–4].

Camellia assamica(Masters) or the Assam tea plant belongs to North East India. It is considered small although it is between ten to fifteen meters tall (Figure 2). The trunk of this tree equals the third of its height. It has a strong branch system. Warm weather conditions suit it well. Leaves are dependent, thin, and shiny. They are pointed in shape. We can distinguish marginal veins easily. The leaf blade is usually oval. It is between 8–20 cm long and 3.5–7.5 cm wide. The leaves are either hairless or hairy on the vein below [1–4].

Combining the two species, we have new plants that may be developed to live in different conditions. Like the Camellia assamica sub sp. Lasiocalys (Planch. MS) and the Cambodiensis or southern...
form of tea which is a small tree that has upright branches and it is between 6–10 m tall (Figure 3).

This tree needs a great amount of water so the region between the cancer and Capricorn tropics is quite suitable for it. The amount of rain there is between 1000 to 1250 mm a year and the heat is between 10 to 30 degrees which is suitable for this tree. It lives in pieces of land that are 2400 meters high from the sea. Tea bushes must be trimmed every four to five years. This will help them stay healthy and low enough for the people who pick the tea which is known as “Plucking Table”. Any tea bush continues to give good tea for 50 to 70 years, but the amount of tea becomes less after fifty years. Meanwhile the old bushes are replaced by new trees that are grown on the estate nursery.

Time of picking tea leaves relies on the weather conditions. New leaves can be picked up during spring but seven or twelve days interval should be left between the times of picking. Tea gathering is a hard work. To collect a kilo of unprocessed tea you need two or three thousand tea leaves. People who pick the tea should be skilled and able to choose the right time to gather the new grown leaves. The more tender the leaves the better is the tea. Following picking, the gathered tea is taken to factories where it is processed [1–4].

Classification, Processing, Styles and Packaging of Tea

Classification of Tea

Tea has always been classified by many ways: by the color of the finished leaves, by the color of the tea liquor, and by the percentage of oxidation during processing. The aim of tea categorization is to gather different sorts of tea with the same qualities. Despite the classification methods used, there is no method could be used to categorize all tea types. However, the similarity in processing method is the easiest way to achieve this.

Different systems of tea classification are noticed in China and Japan. The six tea Chinese types represent categories that gather tea styles of the same processing methods and finally similar products. Needless to say that Chinese created all the types of tea we drink today. Also, the Chinese are the first people who put the tea classification systems. Most Chinese tea experts recognize these six types of tea: green tea, yellow tea, white tea, oolong tea, black tea, and dark tea. Any of those tea types can be flavored, scented, blended, ground, roasted, aged, or decaffeinated.

On the other hand Japanese system classifies tea considering the method of processing into three groups: Non-fermented tea, Semi-fermented tea and Fermented tea. The most important aspect in Japanese system is the way of activating of oxidizing enzymes (e.g. polyphenol oxidize of peroxidase) contained in leaves. This fermentation process activates the oxidizing enzymes and thus changes the green tealeaves into brown [3–8].

Other feasible aspect to classify tee types is to use the ratio between total phenolics and sum of the major catechins [9] or to employ the amino acid pattern as a possible criterion [10]. These approaches need standardized extraction procedures and analytical methods to gain an overview on the composition of teas from different origins and it is necessary to ensure the authenticity of the origin [11].

Tea Production Process

Different types of tea are produced from fresh tea leaves (Camellia sinensis). The common term for the conversion of tea phenolics is fermentation which is related to the manufacturing of black and Oolong tea. To achieve this conversion, endogenous enzymes are required, especially the polyphenol oxidase. Recently, aeration has been used instead of fermentation because some tea-drinking Muslim countries think that fermentation means that the tea contains ethanol [9].

Green tea manufacture: Oxidation process is not used when making green tea which helps retain the green color and the delicate flavor. Before rolling green tea, the enzymes are deactivated. Chart in figure 4 explains that there are two different types of processing. In Japanese method the fresh tea leaves are steamed with high temperature (100°C) in order to inactivate the oxidizing enzymes of leaves, rolled and dried to get the ideal Japanese green tea. On the other hand the Chinese method uses panning with higher temperature (300-350°C) instead of steaming to prevent the fermentation. The inactivated enzymes do not decompose chlorophyll so the color stays green.

To make sure that no oxidation happens, the tea leaves are either pan fried (Chinese method) or steamed (Japanese method) which prevents the interaction of the enzymes then it is rolled. Withering process is used for some green tea in China; it is omitted in manufacturing, followed by rolling, drying and sorting processes [2,5,8,12].

Black and Oolong tea manufacture: Withering black and oolong tea reduces the moisture in the leaves up to 70% (depending on region) and then air is used to remove it in an unvaried way. Twelve to seventeen hours are needed to accomplish this and at the end of this process the leaf is thin and pliable that it can be rolled easily. The rolling process includes putting the tea leaves into a rolling machine which revolves horizontally on the rolling table and gives the tea leaves their stiff looking. After the rolling process, starts the oxidation with the leaves breaks open. Oxidation gives the tea its flavor and color. The color of the leaves changes from green, into light brown and then into deep brown. When rolling process is finished, tea is either put into specific large boxes or displayed on tables so that the enzymes that are inside the tea leaves start to oxidize because they are exposed to the air. To obtain the full fermented Black tea, the tea leaves are treated mechanically in order to enlarge the enzyme conversion of flavonols. Oxidizing process needs between half an hour to 2 hours. To stop the oxidizing process the tea is dried and the total moisture content is down reduced. Otherwise, to get the semi-fermented Oolong tea the oxidation process is stopped early before the fermentation is completed. The leaves are parched, rolled and then dried [2,5,8,12].

White tea manufacture: This tea is different from other kinds of tea in that it is neither fermented nor the oxidizing enzymes are deactivated. Just the soft white hairy buds with or without the first
tea leaves are picked and dried by a very little process and almost stays untouched. Usually, the liquor of white tea is yellow and mild. There is no clear definition for white tea but rather a hint to its geographic origin (found only in Fujian province), the botanical variety (Camellia sinensis var. khenghebaihao and Camellia sinensis var. fudinbaihao), the manufacture (a minimal processing, just drying, no "fermentation") or the appearance of hairy buds of white tea (figure 5) which differs from green tea buds (Figure 6). Also there is no possibility to differentiate between white and green tea by the ratio between sum of the major catechins and total phenolics [2,5,8,12].

**Yellow and dark Tea manufacture:** Yellow and dark teas are sort of post-fermented tea which is exposed to the open air for several months and several years, respectively. When these two kinds of tea are exposed to micro flora, humidity and oxygen in the air, they undergo auto-oxidation, fermentation and some reactivated oxidative enzymes in the tea. This kind of fermentation affects the smell and taste of the tea. The taste is no more bitter but mild and gives pleasant mouth feel. This class of tea is known as ‘dark tea’, especially in Chinese culture and the East Asian cultures that are influenced by it, because of the dark brown liquors that this class of tea gives. However, what is called black tea in Western culture is referred to as red tea in East Asian culture. It is necessary to mention that Pu-erh tea is the most famous kind of post-fermented tea. Previous to post-fermentation process the fresh tea leaves should be panned, rolled and dried [2,8,12]. We cannot separate processing and grading since they complete each other, and they are basic for the manufacturing of tea. To be packaged and sold, tea should be first submitted to the skill of blenders [13].

**Tea Styles**

Every type of tea has certain styles. In order to classify these styles we need to know the processing steps that each one is exposed to, the used plant cultivar, soil, climate, altitude and latitude together with the intention of the tea maker. So many factors give tea its special characteristics like, weather, altitude, moisture and soil. Season and time of picking through the day may have an effect on the characteristics of tea. For a tea style to be considered authentic, it must be made after specific processing steps, a specific cultivar and terroir. Following is the list of the things that make up a tea style in order of importance.

**Variation in Processing:** Different ways of processing have an effect on the kind of tea. Among these ways is steaming that...
used instead of pan firing which is meant to prevent the enzymes oxidation, percentage of oxidation or different methods of shaping. So the definition of a tea style depends on the differences in the tea processing methods. The shape or colors of the finished leaves, the color or taste of the liquor give teas their names and styles.

Cultivar: Any cultivar of Camellia sinensis may give a tea style or tea type but this outcome may not be authentic. In specific growing regions, cultivars have been bred so that they are processed into a certain style of tea. In such a case there is a mother plant that has been planted especially for commercial production.

Terror: A French expression which refers to soil, climate, altitude, and latitude in a particular region. Tea styles can be named either after their grown region, or considered origin if grown in a certain province like white tea, which can only be found in Fujian province in China [1,2,9,12].

Sorting and Packaging

This is the final and the most important stage in the tea process. At this stage the leaves are classified according to their size then according to their type and appearance. Completing sorting, the tea is packed into provided foil paper sacks, so that the tea stays dry. For larger tea leaves, tea boxes are provided to make sure that the tea leaves are not damaged in transit. It is advisable to keep tea in an airtight dark boxes put in a cool and dry place at homes. Retailers usually sell tea in metal tins that are tightly closed. The glass jars that are used for keeping tea should be kept in closed cupboard away from light. We should not store tea in refrigerators as cold increases water condensation which ruins the tea [2,12].

Ingredients of Tealeaves

The ingredients of the tealeaves are not much different from many other plants. Besides the usual ingredients such as protein, carbohydrate and fat containing tealeaves, some ingredients that give the tea its uniqueness. Key ingredients of the tealeaves and their shares are listed in the dry matter in Table 1 [13].

Vitamins and Minerals in Tea

Tea leaves contain a number of vitamins in very low concentration. The exception is vitamin C (ascorbic acid). In high-quality green teas, the vitamin C content reach up to 0.5% of dry matter. Therefore, one liter of green tea covers more than 50% of the daily requirement of Vitamin C. Due to manufacturing process, the content of all vitamins in black tea is less than in green tea, especially vitamin C [13,14].

Practically fluoride is the most important Mineral in tea. The content of water-soluble fluoride in tea leaves is highly significant. A cup of tea covers 10–15% of the daily requirement for fluoride to protect against tooth decay [15].

Tea Polyphenols

Phenolic compounds are common ingredients in the plant kingdom. The phenolic compounds are among the phytochemicals, since they are not produced and consumed in the primary metabolism of the plant. Their exact functions in the plant are still unknown, where they are synthesized as repellents against pests and diseases, as growth regulators and as dyes of the plant [16]. They contribute significant character of taste, appearance and shape in many fruit crops for e.g. Fruit juices, wines and teas. They basically determine their color, flavor and stability and thus ultimately their quality [13].

The scientific community use today polyphenols, or shortly phenols (formerly tannins) for the phenolic compounds of plants. The plant phenolics can be based on their molecular structure into three sub-groups [17]

- Simple phenols having one aromatic ring and one or more hydroxyl groups, for example, Phenol carboxylic acids.
- Polyphenols, compounds having at least two aromatic rings, each having at least one aromatic hydroxyl group, for example Flavonoids (Figure 7).
- Tannin compounds are toxic, high molecular weight compounds consisting of many subunits (12-16 phenolic groups and 5-7 aromatic rings) and mainly found in tree bark and protect the trees against attacks by herbivores.

Varieties of Phenolic compounds are presented in tea and make up to 30% of the dry weight of the tealeaves. The major tea polyphenols are the catechins, flavonol-O-glycosides, flavonol-C-glycosides, proanthocyanidins and also in black tea theaflavins and thearubigins which arising from the catechins during the fermentation [13,17].

Catechins

In fresh leaves and green tea catechins (Flavanols or Flavan-3-ols) are the most abundant group of phenolic compounds. Most medicinal benefits of the tea can be traced back to these catechins which make up about 70% of the flavonoids fraction.

The major tea catechins are (-)-epigallocatechin 3-gallate (EGCG), (-)-epigallocatechin (EGC), (-)-epicatechin (EC), (-)-epicatechin 3-gallate (ECG), and (+)-catechin (C) (Figure 8).

The inclusion of catechins in the gut is quite low at 10–30%. The intestinal microflora seems to have an important role in the absorption of the catechins. The bacteria in the intestine can metabolize the catechins so that they are better absorbed. The intestinal mechanisms have to enrich the catechins from oral intake to be absorbed. Among the catechins, EGCG predominates not only in terms of quantity (up to 70% of the total catechin content), it seems the substance which makes up the cancer preventive properties of tea. In the lab, a wide range of effects was detected on the tumor cells [17].

The catechins have a number of other effects attributed to such as lowering cholesterol levels, lowering blood sugar, anti-bacterial effect, etc [18,19]. Catechins are the main carriers of the health benefits of green tea but they are also toxic in high concentrations (intake of Catechins capsules).

<table>
<thead>
<tr>
<th>Polyphenols</th>
<th>20-30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caffeine</td>
<td>3-5%</td>
</tr>
<tr>
<td>Minerals (water soluble)</td>
<td>2-4%</td>
</tr>
<tr>
<td>Vitamins</td>
<td>0.6-1%</td>
</tr>
<tr>
<td>Amino acids</td>
<td>1-4%</td>
</tr>
</tbody>
</table>

Table 1: Key ingredients of tealeaves and their shares in the dry matter.
Polymerized to form the typical black red dyes thearubigins. Where in the majority of the anti-oxidative effect of the flavonoids is lost. Theaflavins and related compounds consist of four major TFs and minor TF and their related compounds [23]. Thearubigins, which is similar to TFs [24], is produced by the enzymatic oxidation of flavanols during the manufacture of black tea. Researchers showed that the chemical structures of TRs are cyclized skeletons, which have linkages between A- and B-rings of catechins [25,26]. However, further studies are now in progress to elucidate all TRs structures.

**Proanthocyanidins**

Proanthocyanidins (Figure 9) are Flavanol related compounds which degraded during the fermentation of tea and give bisflavanols [20] (Figure 10). Thus green tea has higher amount of Proanthocyanidins and less bisflavanols, while black tea is relatively rich in bisflavanols. There are at least 16 kinds of Proanthocyanidins presented in tea [21,22].

**Theaflavins and Thearubigins**

Theaflavins (TFs) (Figure 11) and thearubigins (TRs) (Figure 12) are the two most important groups of oxidation products. In the production of black tea catechins are oxidized, resulting in theaflavins (yellow reddish pigments in tea). Then theaflavins are polymerized to form the typical the black red dyes thearubigins. Where in the majority of the anti-oxidative effect of the flavonoids is lost. Theaflavins and related compounds consist of four major TFs and minor TF and their related compounds [23]. Thearubigins, which is similar to TFs [24], is produced by the enzymatic oxidation of flavanols during the manufacture of black tea. Researchers showed that the chemical structures of TRs are cyclized skeletons, which have linkages between A- and B-rings of catechins [25,26]. However, further studies are now in progress to elucidate all TRs structures.

**Flavonols (FOG) and Flavones (FCG)**

The Flavonols (quercetin, kaempferol, and myricetin) are presented in tea in form of their mono- di- and tri-O-glycosides.
At least 15 different types of glycosides were isolated from tea [27,28]. Flavonols (Figure 13) content is not very much affected by fermentation and the quercetin 3-rhamnoglucoside has the highest concentration among them. Flavonolglycosids, Flavones (Figure 13) are presented in tea in form of their C-glycosides in much lower concentrations than FOG. C-glycosides are not hydrolyzed by acids or enzymes [29].

**Theanine**

Amino acids comprise another important group of tea components. They make up about 1-4% of the dry weight of tea leaves and have a crucial importance for the fresh and pleasant taste of the tea. The majority of the amino acid portion of the tea leaves (more than 50% for high-quality green teas) is attributable to a particular amino acid, L-Theanine (Figure 14).

Theanine, a derivative of glutamine (N-ethyl-L-glutamine), is contained in tea leaves and other parts of the tea plant (*Camellia sinensis*) and were first discovered in 1949 in tea leaves. It comes in tea in its L-form in the concentration range of 0.5-2% of the dry weight [32,33]. Theanine is synthesized in the roots of tea plant by means of theanine and glutamic acid synthetase from ethylamine, transported into the leaves, and accumulates there. Together with glutamine and other free amino acids theanine is the non-protein nitrogen pool of the plant [32].

Theanine counteracts the caffeine in the tea. Unlike caffeine theanine (dose-dependent) calms central nervous system [30]. In addition, theanine tastes, along with the other amino acids, sweet and it weakens the bitter taste of catechins. L-theanine is together with, inter alia, aspartic acid, theogallin, gallic acid are responsible of the intensity of the “umami” - taste of green tea [32]. Due to their positive influence on the taste, many efforts are being made to increase the content of amino acids in tea, especially in green tea, from the tea company.

It was published in many studies that L-theanine shows important effects in different sciences: physiology, biochemistry, pharmacy and medicine, such as neuroprotective, relaxant, anxiolytic and antihypertensive effects. Most professional publications and studies on the pharmacological effect of theanine are based on animal experiments. Theanine may also increase the release of the hormones serotonin and dopamine and thus improve the learning ability [33]. This connection can inhibit the convulsing effect of caffeine in mice, reduce the psychological and physiological stress reactions, and increase mental relaxation and release emotional stress [34].

However, there are few studies about the effect of the theanine in humans. In a study of 24 healthy volunteers, the effect of L-theanine with and without the co-administration of caffeine has been tested on mental abilities. The administration of theanine alone showed little effects in contrast to the combined administration with caffeine. Thus, theanine does not inhibit, but amplified the stimulating effect of caffeine in humans [35].

The mood effect of theanine has been examined when combined with caffeine. Theanine alone had few effects on mood. The combination of theanine and caffeine had improved mood effects not seen with either treatment alone [31,36,37]. It even...
slows the rate of mental responses of the test persons. Theanine decreases blood pressure, which had been previously increased by the administration of caffeine. Hence, theanine may have different central nervous system effects due to different doses [34].

**Caffeine**

Caffeine (C\textsubscript{8}H\textsubscript{10}N\textsubscript{4}O\textsubscript{2}, 1,3,7-trimethylxanthine or methyltheobromine) is one of the purines scoring highly water-soluble plant alkaloid. In addition to tea, it is included also in coffee, cacao and mate. Pure Caffeine was first isolated in 1820 by Friedrich Ferdinand Runge, of coffee beans. The first caffeine-synthesis was carried out in 1895 by Emil Fischer.

Previously, refers to the caffeine from tea as Tein (also Tein or Theine) to delineate it from the caffeine from the coffee beans. Chemically, caffeine and theine are of course identical (Figure 15). Caffeine is one of the methylxanthenes, is willingly soluble in water, colorless and odorless.

The commercial white, green and black tea contains more caffeine (3-5% of the dry weight of tea) than the roasted coffee (1-1.5% of the dry weight of the coffee beans) [35,38]. However, a cup of coffee includes 2 to 3 times more caffeine than a cup of tea because of the difference of preparation. When using 2.5 g of tea infused with 200 ml of water, a cup of tea contains about 60 mg of caffeine [11].

The caffeine content in tea is influenced by various factors such as: the production area, the height of the region, the weather conditions, and the variety of the tea plant. Also, the caffeine levels in tea vary, because it is a natural product [38].

The pharmacology of caffeine: Caffeine is the most widely used and consumed psychoactive substance. The effect is based on the excitation of the central nervous system. By blocking adenosine receptors it increases mental activity, it will remove fatigue and strengthened intellectual achievements.

After oral intake (tea, coffee, cola, energy drinks), caffeine is absorbed rapidly and completely in the gastrointestinal tract. After 15-45 min caffeine reaches its maximum levels in the blood. The half-life in blood is about 5 hours, but is significantly longer in pregnant women and children.

The stimulating effect of caffeine on the central nervous system is the main reason for the consumption of tea and coffee. This effect is mainly due to caffeine interaction with the surface receptors of nerve cells in the cerebrum. In contrast to coffee, the caffeine in tea is presented in bound form; so that it’s stimulating effect probably slowly unfolds as the enjoyment of coffee. 100–200 mg of caffeine (2–4 cups of tea) leads to a significant influence of psychological basic functions such as drive and mood. The motor activity is increased (e.g. faster typewriting with a lower error rate), the mental tempo faster with less reaction time, lifts the mood, facilitates the learning process. However, the effects are dependent on the habit. They occur in strong tea or coffee drinkers on much weaker than in social drinkers. Another effect of the caffeine, which is also used therapeutically, is pain relief. Caffeine, for example, one of the three drugs in the aspirin Thomapyrin (the other two are aspirin and paracetamol). The conventional wisdom of caffeine as diuretic, urine impulsive action has been refuted. The tea or coffee consumption does not cause more urination than drinking an equal amount of water [11,39].

**Health Benefits of Tea**

According to researches, tea has great benefits for human health due to its composition and the very affective ingredients [39,40]. Tea prevents the progression of some diseases that people have. Following are the most important health benefits of tea:

**Tea and Cancer**

Despite the advanced medical technology for diagnosis and treatment of Cancer, it is still one of the most dangerous diseases that put an end to the life of the person who suffers from it. On the other hand, it is very difficult to kill the tumor cells without harming the normal ones. To target tumor cells biochemical and molecular alterations are applied. Therapies relating to cancer like surgery, chemotherapy, radiation and hormone seem successful but they have their own shortcomings. Almost all cancer drugs have very bad side effects, such as liver damage, oxidative stress and immune suppression because of their concurrent toxic manifestations. Thus, successful cancer chemotherapies should be selective targeting and have low toxicity for normal host tissues [41].

Natural substances are recently studied to use for prevention of cancer and for reducing the cases of mortality and morbidity related to it. Tea polyphenols is considered one of these natural substances that reduce the risk of cancer because of their proved strong antioxidative properties, which affect the molecular mechanisms involved in angiogenesis, metastasis and regulation of cell death. In addition to antioxidative properties of green tea catechins, studies showed their effects on the molecular mechanisms involved in angiogenesis. Green tea flavonoids and in particular, EGCG which is the major green tea polyphenol possess anti-angiogenic activities that could account for the tumor prevention effects observed with these compounds [2,18,19,42–44].

Recently epidemiological observations gave some convincing evidences that polyphenolic antioxidants present in the tea and in particular EGCG, EGC and ECG, may decrease the risk of prostate cancer. Some studies on animals and a recent Chinese human study showed that the risk of prostate cancer declined by increasing the consumption of green tea [18,42–44].

EGCG is expected to have an important role in preventing and treating prostate, colon and also gastric cancer. Because of their biological activity as antioxidant, antiangiogenesis and antiproliferative, green tea catechins may be a good candidate to prevent and treat various kinds of cancer. In Japan, Tee-polyphenols and in particular EGCG are now considered a cancer preventive beverage [19,39,41–44].

Most of the relevant mechanisms of cancer prevention by tea polyphenols are not related to their redox properties, but to target molecules, including the inhabituation of selected Protein kinases, matrix metalloproteinases and DNA methyltransferases. Many studies assured that tea and its polyphenols decrease the risk of skin, lung, colon, liver and pancreatic cancer [42–46]. Tea can also benefit white blood cells during chemotherapy treatment [40,43].
Tea and Immune System

Antioxidants stop free radicals and consequently slow degenerative diseases. Free radicals hurt the body cells by causing chain reactions of electron scavenging. The antioxidative activity levels of flavonoids and other polyphenols in tea are very different. The positive immune system effects of tea are due to containing considerable amounts of polyphenols [40,47]. Because of the minimal proceed, green and white teas contain the highest amount of polyphenols [16,48]. Four cups of green tea can give the recommended dietary value of polyphenols (300 to 400 mg).

Tea and cavities

Because tea contains fluoride and other minerals, it fights cavity and maintain hard teeth. The polyphenols exist in tea help fight bacteria in the mouth. In vitro and in vivo experiments clearly show that the group of polyphenols represents a caries-preventive factor of tea. Polyphenols in tea inhibit the degradation of starch in food particles on the teeth by inactivation of amylase. Tannins in black tea have a better activity in the Amylase hemming than catechins in green tea, because of their high molecular weight.

Tea prevents caries, improves and preserves the tooth substance, reduces cariogenic risk of crackers and cookies as a source of fermentable carbohydrates in the oral cavity [40,49]. This can be regarded as another positive factor of drinking tea.

Tea and Heart Diseases

Worldwide, cardiovascular diseases consider the main cause of morbidity and mortality. Many epidemiological researches refer to the connection between tea consumption and several beneficial cardiovascular effects. These studies indicate that tea flavonoids and catechins inhibit the risk of detrimental cardiovascular diseases, and decrease their mortality rate. Tea catechins decrease oxidative stress, prevent inflammatory events, reduce platelet aggregation and halt the reproduction of vascular smooth muscle cells, so they have the ability to keep from hypertension, atherosclerosis, cardiomyopathy, ischemic heart diseases, cardiac hypertrophy and congestive heart failure.

The anti-oxidant effect of catechins is accorded by inhibiting pro-oxidant enzymes, scavenging free radicals and stimulating anti-oxidant enzymes. Catechins conflict with vascular growth factors and also reduce the proliferation of vascular smooth muscle cell because of their anti-inflammatory activity. In addition, catechins adjust blood pressure, promote vascular integrity and save vascular endothelial cells [40,41,50–52].

Depending on some animal and human studies, the protect effectivities of cardiovascular diseases of black and green are equal. During the fermentation of black tea, catechins are converted to other components (theaflavins and thearubigins), which have in vitro, cardiovascular beneficial effects. Other in vivo studies are required to assure that [52].

Tea and Obesity

Tea as a metabolic stimulant is drunk with each meal for weight loss. Caffeine may increase metabolism of fatty acids for energy and spare glycogen stores. In comparison with other commercial beverages, all kinds of tea offer low calories. Every serving of tea has only four calories and drinking tea without any addition is healthier. Tea-caffeine raises body function so it helps to burn more calories and the tea-polyphenols helps in fat digestion [46,53–55].

Tea and Anti-Diabetic Effects

Diabetes is a disorder of carbohydrate metabolism in which the sugar level increases in the blood beyond the normal level. In diabetic patients, reduced antioxidant defenses are observed and consequently the risk of free radical mediated disease is increased. Some new researches suggest the dietary of flavonoids to lower the risk of diabetes, but the results of a biological effect has yet to be proved directly in humans [56,57]. Chemical analysis has indicated that tea is a source of many flavonoids which are reported to have a glucose-lowering effect in animals [58]. The exact mechanisms of the anti diabetic effects of tea are not clear, although several hypotheses have been proposed. Tea components work like Insulin; they raise the activity of phosphoinositide 3-kinase, tyrosine phosphorylation, mitogen-activated protein kinase of the insulin receptor. Free radical mediated diseases are also known to be reduced by tea components due to their antioxidant properties. Thus tea can be considered as a natural anti-diabetic medicine without any toxicity in animals [58]. Tea is therefore worthy of serious consideration for further investigation in respect of the prevention and treatment of diabetes.

Side Effects of Tea

Several good effects of tea on human health are proved for various diseases or issues, but there are some harmful effects too. The flavonoids in tea have the most therapeutic and nutritional benefits. However, they can be toxic, when their consumption exceeds certain limits. They affect human health badly by formation of reactive oxygen species, which harm the lipid membranes and also the DNA [61].

Side effects and toxicity of caffeine are very low. The lethal dose for humans is about 10 grams. Like other ergogenic substances, cause caffeine often abuse effects. For example the athletes drink caffeine as a doping agent to remove fatigue and to strengthen intellectual achievements, but excessive caffeine intake causes headaches. Also consuming larger doses of Caffeine (about 300 mg), lead to symptoms such as Palpitations and hand tremors [62,63].

In addition to several beneficial minerals (magnesium, calcium, potassium, and phosphorus), tea contains also some bad elements (lead and aluminum). Some researchers showed that the brewed teas for three to fifteen minutes contain considerable lead levels (73% to 83%), respectively, and also the aluminum levels were above recommended guidelines. This make tea unsafe beverage for pregnant and lactating women. Tea can have a toxic contamination on heavy metals and that is depending on the dose intake of tea [61,64]. However, the benefits and side effects of tea are still to be studied.

Conclusion

Various types of tea can be obtained from the tow tea plants Camellia sinensis L. and Camellia assamica by applying different manufacturing processes on the fresh tea leaves. During production processes tea ingredients undergo chemical changes in particularly polyphenols. Thus tea types vary in colour (black, green, white and oolong tea) and taste.

Tea is classified in many ways according to: origin, similarity of final products (green, yellow, white, oolong and black), the grade of fermentation (Non-fermented, Semi-fermented and Fermented), or ratio approach between major tea components.

Caffeine, theanine and polyphenols are the most effective compounds of tea. Flavonoids have diabetes, cancers and heart diseases prevention effects. Catechins, in particular, (EGCG) inhibit the risk of detrimental cardiovascular diseases and help in inflammation skin therapy caused by solar UV radiation. The antioxidant activities of Polyphenolsenhance the human immune system and reduce the Obesity. Caffeine helps to burn more calories and digest fat. Tannins hemmed amylase and fight cavity. Although of large positive effects of tea, consuming large amounts of long brewed tea can have a toxic contamination by heavy metals and other ergogenic effects. More studies and researches are still needed to reveal the benefits and side effects of tea.

Conflict of interest

Authors declared that they have no conflict of interest.

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