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A Review on the Pharmacognostical Preliminary Phytochemical Screening and Antioxidant Activity of Thea Sinensis Leaves

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Abstract

Introduction: Tea (*Camellia sinensis*) is the most highly consumed beverage in the world in addition to water. The most common way of preparation is by immersing the tea bag in hot or cold water. In Colombia, it is a recent trend and the market is growing continuously.

Objective: The objective of this study is to compare the antioxidant characteristics of four brands of green tea sold in Colombia at room and hot temperature in relation to the preparation conditions.

Methods: The commercial brands of green tea (Oriental®, Lipton®, Hindu®, Jaibel®) were used in an aqueous extraction at two temperatures: Cold tea extract (25°C) and hot tea extract (80°C). Total Polyphenol Concentration (TPC) was determined by Folin-Ciocalteu method; Total Flavonoid Content (TFC) was determined by spectrophotometric method and the antioxidant capacity was determined by two methods: DPPH radical capture assay and the Oxygen Radical Absorbance Capacity (ORAC) assay. Finally, a method to quantify the catechins of the tea extracts, High Performance Liquid Chromatography (HPLC) was applied.

Results: The TPC vary between: 2.53 mg GAE/g-14.63 mg GAE/g sample for cold tea extract and 29.34 mg GAE/g-55.06 mg GAE/g sample for hot tea extract. The TFC vary between: 2.67 mg CE/g 7.08 mg CE/g per sample for the cold tea extract and 5.43 mg CE/g-8.41 mg CE/g sample for hot tea extract [14]. A similar profile assays: For cold tea extract: 22.36 mg TE/g-41.29 mg TE/g sample for DPPH and 22.95 mg TE/g-46.25 mg TE/g sample for ORAC. Similarly, for hot tea extract the following ranges were: 38.50 mg TE/g-110.01 mg TE/g sample for DPPH and 23.40 mg TE/g-113.60 mg TE/g sample for ORAC. In general, the values obtained in each assay for each brand were as follows: Oriental®>Lipton®>Hindu®>Jaibel®. The chromatographic profiles showed the presence of ten compounds.

Conclusion: These results confirm that the aqueous extraction of green tea at 80°C leads to the formation of infusions made up of compounds with higher antioxidant capacity in comparison with extractions at room temperature.

Keywords: Physiological; Antioxidant; Phytoconstituents; Lungs

Introduction

The objective of the present study was to evaluate the phytochemical constituents and antioxidant activity of Thea sinensis, the tea plant belonging to the family *Theaceae*. The medicinal value of plants lies in some chemical substituents that produce a definite physiological action on human body. Many plant extracts have been reported to have multiple biological effects such as antioxidant, antimicrobial, antifungal and anticarcinogenic activity. This is due to their phytoconstituents. Some of the most important bioactive constituents are alkaloids, tannins, flavanoids and phenoliccompounds. The increased consumption of green tea is due to it's antioxidant property. Antioxidants are chemical substances used for treating various human diseases related to heart, lungs, kidney, muscle, brain and helps to control ageing process. They mainly function in human body by inhibiting or delaying the formation of free radicals and lipid peroxidation that are mainly responsible for many human diseases and ageing process. Oxidative stress occurs when there is an increased production of free radicals and decreased levels of antioxidants in the body. Lipid peroxidation is an oxidative process that undergoes in a series of reactions. It is mediated by some free radicals generated in the body like peroxinitrite, hydroxyl radicals, hydrogen peroxide, superoxide radicals. Free radicals are molecules that contain one or more unpaired electron in it's outer shell, which makes them less stable and highly reactive compound further initiating harmful chain reaction and damage biomolecules in cell. The presence of different phytochemicals such as ascorbic acid, tocopherols, carotenoids and polyphenolic compounds and their combined activities results in the total antioxidant activity of a plant Other compounds are alkaloids, (caffiene, theophylline, theobromine) amino acids, carbohydrates, proteins, chlorophyll volatile organic compounds. fluoride, aluminium, minerals and trace elements. The increased consumption of green tea is due to it's antioxidant property. Tea is consumed world wide and is second to water in it's popularity as a beverage. Green tea is generally safe, non toxic and has no side effects after

consumption. Research suggests that green tea also possess medicinal properties including antimicrobial, anti fungal and anti carcinogenic activity. The beneficial effects of green tea are due to it's polyphenolic compunds. Among the polyphenols flavanoids of tea especially catechins are the leading functional components. Fresh green tea leaves are very rich in catechins. The polyphenols are large group of plant chemicals includes catechins. Mostly catechins are Epicatechin Gallate (ECG), Epicatechin (EC), Epigallocatechin (EGC), and epigallocatechingallate. The most active and abundant catechin in green tea is Epigallo Catechin-3-Gallate (EGCG). Epigallocatechingallate is viewed as the most significant active component. The leaf bud and first leaves are richest in EGCG. The usual concentration of total phenols in dried green tea leaves is 8%-12%. Other compounds of interest in dried green tea leaves includes gallic acids, quercetin, kaempferol, myricetin, caffiec acid, and chlorogenic acid [1].

Literature Review

Tea is made from the leaf of the plant *Camellia sinensis* belonging to the family *Theaceae*. After harvesting tea leaves begin to wilt and oxidize. During oxidation the chemicals in the leaves are broken down by enzymes, resulting in darkening of the leaves and well recognized aroma of tea. Tea is reported to contain nearly 4000 bioactive compounds of which one 3rd is contributed by polyphenols. Other compounds are alkaloids, (caffiene, theophylline, theobromine) amino acids, carbohydrates, proteins, chlorophyll volatile organic compounds. Fluoride, aluminium, minerals and trace elements. The increased consumption of green tea is due to it's antioxidant property. Tea is consumed world wide and is second to water in it's popularity as a beverage. Green tea is generally safe, non toxic and has no side effects after consumption. Research suggests that green tea also possess medicinal properties including antimicrobial, anti fungal and anti carcinogenic activity (Figure 1) [2].

Figure 1: Green tea is made from the leaf of the plant *Camellia sinensis.*

The beneficial effects of green tea are due to it's polyphenolic compunds. Among the polyphenols flavanoids of tea especially catechins are the leading functional components. Fresh green tea leaves are very rich in catechins. The polyphenols are large group of plant chemicals includes catechins. Mostly catechins are Epicatechin Gallate (ECG), Epicatechin (EC), Epigallocatechin (EGC) and epigallocatechingallate. The most active and abundant catechin in green tea is Epigallo Catechin-3-Gallate (EGCG). Epigallocatechingallate is viewed as the most significant active component. The leaf bud and first leaves are richest in EGCG. The usual concentration of total phenols in dried green tea leaves is 8%-12%. Other compounds of interest in dried green tea leaves includes gallic acids, quercetin, kaempferol, myricetin, caffiec acid and chlorogenic acid [3].

Health benefits

The secret of green tea lies in the fact that it is rich in catechins, polyphenols, particularly EGCG. The EGCG is a powerful anti oxidant. Besides inhibiting the growth of cancer cells, it kills cancer cells without harming healthy tissue. It has also been effective in lowering LDL cholesterol levels, inhibiting the abnormal formation of blood clots, reduction of platelet aggregation, lipid regulation and inhibition of proliferation and migration of smooth muscle cells (Figure 2) [4].

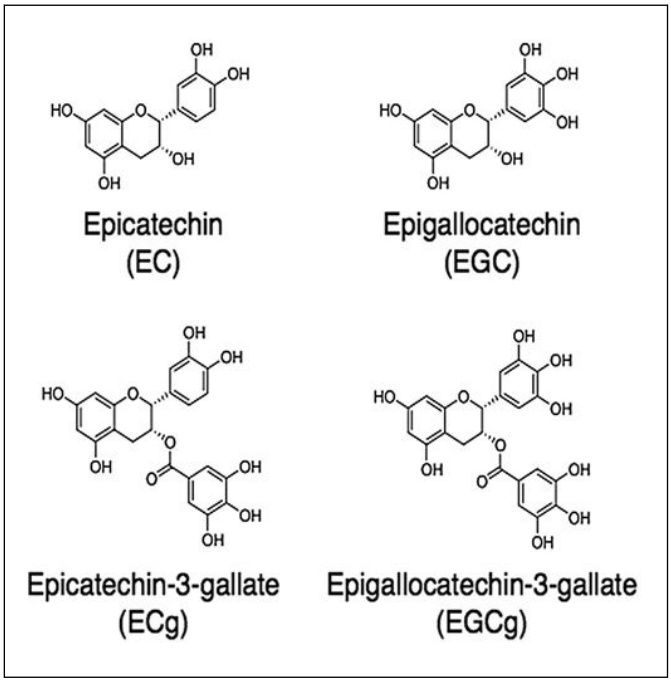

Figure 2: Variations of epigallocatechin 3 gallate.

The major and most chemo preventive constituent in green tea responsible for these biochemical or pharmacological effect is (-)-epigallocatechin-3-gallate.

Green tea and cancer prevention: According to national cancer institute the polyphenols in tea have been shown to decrease tumor growth in laboratory and animal studies. Some

studies also shown the positive impact of green tea on the following types of cancer.

- Breast
- Bladder
- Ovarian
- Colorectal
- Esophageal
- Lung
- Skin
- Stomach

Researchers believes that it is the high level of polyphenols in tea that helps in killing the canceruos and stop them from growing.

Green tea heart benefits: Green tea consumption is associated with reduced mortality due to all causes including cardiovascular diseases.

Green tea and lower cholesterol: An analysis of published studies in 2011 found that consuming green tea either as a beverage or in capsule form, was linked to significant but modest reductions in total and LDL or bad cholesterol.

Green tea for type 2 diabetes: Studies concerning the relationship between green tea and diabetes have been inconsistent. Some have shown lower risk of developing type 2 diabetes for green tea drinkers than for those who consumed no tea.

Green tea and weight loss: Green tea may promote a small, non significant weight loss in over weight and obese adult.

Plant profile

Kingdom: *Plantae*

Order: *Ericales*

Family: *Theaceae*

Genus: *Camellia*

Species: *Camellia sinensis*

Green tea contains about 30 mg to 60 mg of caffeine per 6 oz. to 8 oz. cup. This is normal and less than the average 100 mg caffeine contained in a cup of coffee. But green tea is generally consumed in greater amounts when used for weight loss, this increases the consumption of caffeine. It will raise caffeine intake unsafe levels and may increase risk of insomnia, restlessness, tremors and upset stomach. Tannins are also present in large quantities in green tea (catechins, epicatechins) bind with non heme iron in the body, this interferes with iron absorption which can lead to iron deficiency anemia. Iron defeciency anemia can cause feeling of weakness, shortness of breath, irritability, headaches and irregular heart beats [5].

Since green tea is a diuretic and it can cause excessive urination which may lead to dehydration and electrolyte imbalance. If severe dehydration occurs it may cause headaches, lethargy, altered heart rate and shock. Green tea contains polyphenols, the researchers showed that it may stain the teeth. Nausea, vomiting, lose of appetite, abdominal bloatingor pain, flatulance are other side effects (Table 1) [6].

Table 1: Catechin in green tea infusion.

Catechin in green tea infusion	Catechin concentration (mg/L)	Catechin concentration (mg/8 fl oz)
Epigallocatechin-3-Gallate (EGCG)	117-442	25-106
Epigallocatechin (EGC)	203-471	49-113
Epicatechin-3-Gallate (ECG)	17-150	13241
Epicatechin (EC)	25-81	43617

Green tea is consumed throughout the world in various forms. The years of safe consumption of this beverage, supported by numerous studies showing health benefits, warrant a general recommendation to consume it regularly. This article demonstrates the benefits of green tea for its anti inflammatory and antioxidant potential. It has been used to treat cardiovascular diseases, oral cavity diseases, cardiovascular uses and parkinson's disease. There is also a wide range of uses for green tea in diabetes, exercise enhancement, inflammatory bowel disease and skin disorders [7]. Most impressive are the well controlled epidemiologic studies, aimed at altering the brain ageing process, which can serve as neuroprotective agents. Although the human clinical data is still limited, this article shows that green tea has its place in both the conventional and alternative medical communities.

Globally, traditional and herbal teas are a prominent dietary source of polyphenols and represent a class of bioactive molecules that are closely associated with a variety of health benefifits. Most consumers prepare tea using tea bags, although there is little information about whether thisproduction step alters the content of the fifinal product [8]. The study purpose was to investigate the effect of steep time and tea type on the polyphenol content and predicted antioxidant capacity of commercially available tea bag products, including green, orange pekoe, red roiboos, peppermint and chamomile. Total Polyphenol Content (TPC), antioxidant capacity (1,1-diphenyl-2-picrylhydrazylinhibition) and total predicted antioxidant capacity were measured in aliquots sampled every minutefor 10 min. Polyphenols were extracted into solution in a nonlinear fashion, with ~ 80%-90% of the TPC appearing within 5 min of tea bag immersion. Moreover, a significant range in TPC values was observed between products, with true teas containing at least two fold greater polyphenol content than the herbal varieties. Our results are consistent with previous work using loose leaf tea productsand demonstrates that tea bag products are an effective source of polyphenols that may offer health benefifits relating to their constituent antioxidant activity [9].

Discussion

Green tea, which is produced from the leaves of the *Camellia sinensis* plant, is one of the most popular beverages worldwide. Over the past 30 years or more, scientists have studied this plant in respect to potential health benefifits. Research has shown that the main components of green tea that are associated with health benefifits are the catechins. The four main catechins found in green tea are (-Epicatechin (EC), (-Epicatechin-3-Gallate (ECG), (-Epigallocatechin (EGC) and-Epigallocatechin-3-Gallate (EGCG). Of these four, EGCG is present in the largest quantity and so has been used in much of the research. Among the health benefifits of green tea are: Anticarcinogenic, anti inflflammatory, antimicrobial and antioxidant properties and benefifits in cardiovascular diseaseand oral health. Research has been carried out using various animal models and cells lines, and is now more and more being carried out in humans. This type of research will help us to better understand the direct benefifits of green tea. This review will focus primarily on research conducted using human subjects to investigate the health benefifits of green tea [10].

The objective of the present study was to evaluate the phytochemical constituent and antioxidant activity of green tea and guduchi aqueous extract. Phytochemical screening was performed by the well known tests protocol available in the literature using standard. The antioxidant properties of aqueous extract of selected plants were evaluated, through determination of H_2O_2 radical scavenging assay. The phytochemical screening revealed the presence of various phytoconstituents and showed greater H_2O_2 radical scavenging assay activity (IC50=155.003 and 169.7683). Consequently, the plants would be considered as promising sources of antioxidant phytochemicals [11].

Green tea is obtained from the plant *Camellia sinensis* belonging to family *Theacae*. From ancient times tea is drunk worldwide as a beverage in the form of a decoction. It was used to detoxify the body. This attracted many scientists to work on green tea and discover its therapeutic properties. One of them is its antimicrobial property in curing various infections. Considering this, the present review has been focused on the antimicrobial aspect of green tea. This includes the history of green tea, its pharmacognostical study, chemical constituents, role and mechanism of its main chemical constituent catechinincur ing anti microbial infections and other ailments. And finally scope of green tea for further research and in designing and formulating drugs of it has been pondered over [12].

Green tea is obtained from *Camellia sinensis* and belongs to the family *Theaceae* and is used most popularly as beverage all over the world. Although there are beneficial effects of green tea, but it has also side effects. We have search different research articles and found that by consuming large amounts of green tea nausea, vomiting, dehydration, lethargy, central nervous system stimulation such as dizziness, insomnia, tremors, restlessness, confusion, diuresis, heart rate irregularities and psychomotor agitation may occur. Most side effects are due to high consumption of caffeine. Epigallocatechin-3-Gallate (EGCG) has anti folate activity so to prevent folate deficiency it should not used in excessive quantity and it may reacts with some drugs like aspirin and MAOI so used with caution if high level of green tea is used [13].

In the present study, we aimed to develop a Novel Fermented Tea (NFT) product and to evaluate their *in vitro* antioxidant potential and chemical composition. We found that NFT containeda high level of total phenolic compounds (102.98 mg gallic acid equivalents/g extract) and exhibited diverse antioxidant activities, such as scavenging of 1,1-Diphenyl-2-Picryl Hydrazyl (DPPH) andhydroxyl radicals, as well as reducing power. The total catechins in NFT were comparable to those of Lipton Black Tea (LBT), but lower than those of Boseong Green Tea (BGT) or Tieguanyin Oolong Tea (TOT). Among all catechins tested, Epigallocatechin [14]. (EGC) and Epigallocatechin-3-O-Gallate (EGCG) were the predominant compounds in NFT. In particular, the contents of total Theaflflavins (TFs), Theaflflavin (TF), Theaflflavin-3-Gallate (TF3G) and Theaflflavin-3'-Gallate (TF3'G) in NFT were signifificantly higher than that of BGT, TOT or LBT. NFT had the highest level of total essential amino acid and Y-Aminobutyric Acid (GABA) compared with BGT, TOT and LBT. Furthermore, the sensory evaluation results showed that NFT had satisfactory color, aroma, taste and overall acceptability scores. Our results highlight the potential usefulness of this novel fermented tea as a nutraceutical food/ingredient with special functional activities [15].

Tea is one of the most widely consumed beverages worldwide and is available in various forms. Green tea is richer in antioxidants compared to other forms of tea. Tea is composed of polyphenols, caffeine, minerals and trace amounts of vitamins, amino acids, and carbohydrates. The composition of the tea varies depending on the fermentation process employed to produce it. The phytochemicals present in green tea are known to stimulate the central nervous system and maintain overall health in humans. Skin aging is a complex process mediated by intrinsic factors such as senescence, along with extrinsic damage induced by external factors such as chronic exposure to Ultraviolet (UV) irradiation-a process known as photoaging-which can lead to erythema, edema, sunburn, hyperplasia, prematureaging and the development of non-melanoma and melanoma skin cancers. UV can cause skin damage either directly, through absorption of energy by biomolecules or indirectly, by increased production of Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS). Green tea phytochemicals are apotent source of exogenous antioxidant candidates that could nullify excess endogenous ROS and RNS inside the body and thereby diminish the impact of photoaging. Several *in vivo* and *in vitro* studies suggest that green tea supplementation increases the collagen and elastin fiber content, and suppresses collagen degrading enzyme MMP-3 production in the skin, conferring an anti wrinkle effect. The precise mechanism behind the anti photoaging effect of green tea has not been explored yet [16]. Studies using the worm model have suggested that green tea mediated life span extension depends on the DAF-16 pathway. Apart from this, green tea has been reported to have stress resistance and neuroprotective properties. Its ROS scavenging activity makes it a potent stress mediator, as it can also regulate the stress

induced by metal ions. It is known that tea polyphenols can induce the expression of different antioxidant enzymes and hinder the DNA oxidative damage. Growing evidence suggests that green tea can also be used as a potential agent to mediate neurodegenerative diseases, including Alzheimer's disease. EGCG, an abundant catechin in tea, was found to suppress the neurotoxicity induced by Aβ as it activates Glycogen Synthase Kinase-3β (GSK-3β), along with inhibiting c-Abl/FE65-the cytoplasmic nonreceptor tyrosine kinase which is involved in the development of the nervous system and in nuclear translocation. Additionally, green tea polyphenols induce autophagy, thereby revitalizing the overall health of the organism consuming it. Green tea was able to activate autophagy in HL-60 xenographs by increasing the activity of PI3 kinase and BECLIN-1. This manuscript describes the reported anti photoaging, stress resistance and neuroprotective and autophagy properties of one of the most widely known functional foods green tea [17].

The potential health benefits attributed to green tea and its catechins such as antioxidant effects, cancer chemoprevention and weight loss have led to a huge increase of green tea products in the food market. The objectives of this work were to analyze and compare these products in terms of phenolic contents and *in vitro* antioxidant capacity including tea bags, dehydrated leaves and ready to drink preparations after standardization of the infusion preparation procedure. Total phenolics content in 1 cup of the different teas varied from 90 mg to 341 mg of catechin equivalents and the highest and the lowest values were both those of the ready to drink products. Infusions prepared from tea bags had contents varying from 96 mg to 201 mg. 200 mL^{-1} and there were no significant differences among batches. The DPPH radical scavenging and the Oxygen Radical Absorbing Capacities (ORAC) varied largely among the different tea preparations, from 23 mmoles to 131 mmoles of Trolox Equivalents (TE). 200 mL^{-1} (DPPH) and from 1.2 mmoles to 5.1 mmoles of TE. 200 mL^{-1} (ORAC), but again there were no differences among infusions or ready to drink commercial preparations. However, the antioxidant capacity of ready to drink products was partially due to the presence of other non phenolic compounds such as ascorbic acid.

Green tea has higher concentrations of catechins than in black tea. Catechin is a natural phenol and antioxidant and is thought to be responsible for many of green tea's health benefits. It is found that weight gain was greatly reduced by diets supplemented with many of these green tea components, but particularly with the diet which combined caffeine and catechin. Green tea may actually help in the prevention of caries. Other benefits are increased thermogenesis (heat production), increased fat oxidation, increased glucose uptake in muscles, decreased fat content in liver and increased fecal excretion of fats. This review is done to spread awareness among general population about the benefits of green tea [18].

The objective of this study was to determine the relationship between the plucking periods and the major constituents and the antioxidant activity in green tea. Green tea was prepared from leaves plucked from the end of April 2013 to the end of May 2013 at intervals of one week or longer. The contents of theanine, theobromine, caffeine, Catechin (C) and Gallocatechin gallate (GCg) were significantly decreased, whereas those of Epicatechin (EC), Epigallocatechin gallate (EGCg) and Epigallocatechin (EGC) were significantly increased along with the period of tea leaf plucking. In addition, antioxidant activity of green tea and standard catechins was investigated using ABTS, FRAP and DPPH assays. The highest antioxidant activity was observed in relatively the oldest leaf, regardless of the assay methods used. Additionally, the order of antioxidant activity of standard catechins was as follows: EGCg ≥ GCg ≥ ECg>EGC ≥ GC ≥ EC ≥ C. Moreover, the cis catechins contents were the key factor affecting the antioxidant activity of green tea in all assays employed (ABTS, $r=0.731$, $p<0.01$; FRAP, $r=0.886$, $p<0.01$; DPPH, $r=0.778$, $p<0.01$).

Reactive Oxygen Species (ROS) are present in low concentrations in the genital tracts of males and females. Excessive ROS lead to oxidative stress, which damages DNA, lipids and proteins. Such molecular changes result in compromised vitality, increased morphological defects and decreased sperm motility in the male. In the female, oxidative stress interferes with oocyte maturation and may inhibit in vitro maturation of the oocyte. Recently, green tea supplementation has been reported to possess properties that may improve the quality of male and female gametes largely due to the ability of catechin polyphenols to quench ROS. Epigallocatechin 3 Gallate (EGCG) is considered the most pr omising bioactive compound in green tea due to its strong antioxidant activity. The unique property of green tea catechins may potentially improve reproductive health and pose an important research area. We present a comprehensive overview on the effects and potential roles of green tea catechins on oxidative stress in male and female reproduction and fertility. In this review, possible mechanisms of action are highlighted to better understand the potential use of green tea catechins in the reduction of oxidative stress and its associated benefificial effects in the clinical setting [18].

Levels of essential elements with antioxidant activity, as well as catechins, gallic acid and caffeine levels, in a total of 45 samples of different teas commercialized in Spain have been evaluated. Chromium, manganese, selenium and zinc were determined in the samples mineralized with HNO_3 and V_2O_5, using ETAAS as the analytical technique. The reliability of the procedure was checked by analysis of a certified reference material. Large variations in the trace element composition of teas were observed. The levels ranged from 50.6 ng/g to 371.4 ng/g for Cr, from 76.1 µg/g to 987.6 µg/g for Mn, from 48.5 ng/g to 114.6 ng/g for Se, and from 56.3 ng/g to 78.6 ng/g for Zn. The four major catechins [(-)-Epigallocatechin Gallate (EGCG), (-)-Epigallocatechin (EGC), (-)-Epicatechin Gallate (ECG) and (-)-Epicatechin (EC)], Gallic Acid (GA) and caffeine were simultaneously determined by a simple and fast HPLC method using a photodiode array detector. In all analyzed samples, EGCG ranged from1.4 mg/g to 103.5 mg/g, EGC from 3.9 mg/g to 45.3 mg/g, ECG from 0.2 mg/g to 45.6 mg/g and EC ranged from 0.6 mg/g to 21.2 mg/g. These results indicated that green tea has a higher content of catechins than both oolong and fermented teas (red and black teas); the fermentation process during tea manufacturing reduces the levels of catechins significantly.

Gallic acid content ranged from 0.039 mg/g to 6.7 mg/g; the fermentation process also elevated remarkably gallic acid levels in black teas (mean level of 3.9 (1.5 mg/g). The amount of caffeine in the analyzed samples ranged from 7.5 mg/g to 86.6 mg/g and the lower values were detected in green and oolong teas. This study will be useful for the appraisal of trace elements and antioxidant components in various teas and it will also be of interest for people who like drinking this beverage.

This study compared the Total Phenolic Content (TPC), Total Flavonoid Content (TFC), Ferric Reducing Antioxidant Power (FRAP), DPPH radical scavenging capacity and caffeine content of teas (black, green, white, chamomile and mixed berry/hibiscus) over a range of infusion times (0.5 mins-10 mins) at 90°C. Green, followed by black tea, respectively, had the greatest TPC (557.58 µg GAE/g and 499.19 µg GAE/g), TFC (367.84 µg QE/g and 325.18 µg QE/g), FRAP (887.38 µg TE/g and 209.38 µg TE/g) and DPPH radical scavenging capacity (1233.03 µg AAE/g and 866.39 µg AAE/g). Caffeine content per cup (200 mL) in black, green and white tea was 63 mg, 51 mg and 49 mg respectively. Changes in the phenolic content and antioxidant capacity of teas were modelled using zero, first and Fractional Conversion First Order (FCFO) kinetic models. Results fitted a FCFO kinetic model, providing useful data for maximum phytochemical preservation in the optimisation of industrial and domestic processing. As a dietary comparison, green, black and white tea were found to have a greater phenolic content and antioxidant capacity than fresh orange and apple juice. It can be concluded that green and black teas are significant sources of dietary phenolic antioxidants.

Brewed green tea has been associated with just about everything healthy immunity boosting to prevention of chronic diseases. Speculations about the benefits of green tea range back to ancient times, but their bio activities are yet to be established. The antioxidants in green tea (catechins) are shown to slow the growth of cancer cells, reduce the size of tumors and soften the sharp side effects of chemotherapy. In Asian countries green tea is consumed as plain brewed tea, but in western countries the popularity of tea is for the flavored green tea available in the market. All existing research work documents health benefits of plain green tea, but studies on flavored teas are not as widespread. In this paper, various flavored green teas were analyzed and compared with plain green tea for anticancer and antioxidant capabilities. Jasmine and blueberry showed the strongest anticancer properties whereas the most antioxidant was jasmine.

Antioxidant activity of different types of tea (green, oolong, black, pu erh) were measured using different modern methods. Several types of commercially available teas, from various manufacturers were tested for antioxidant content using the amperometric method, the data is displayed here. Data gathered about antioxidant content of these different tea samples can be used to estimate quality and type of tea. The data collected using this method is also important when trying to account for the normal daily consumable antioxidant of healthy people and also patients using clinical antioxidant therapy.

The most abundant compound was gallic acid, followed by caffeic acid, rutin, (+)-catechin and (-)-epicatechin. The main procyanidin was procyanidin B1. The antioxidant activity was measured using five *in vitro* methods: Determination of 1,1-Diphenyl-2-Picrylhydrazyl radical scavenging activity (DPPH), 2,2'-azino-bis(3-ethylbenzthiazoline-6-sulphonic acid) radical cation scavenging activity (ABTS), Ferric Reducing Antioxidant Power (FRAP), Reduction Power (RP) Fe(III) to Fe(II) and Cyclic Voltammetry (CV). Obtained results of FRAP and of the Fe (III)/Fe (III) method correlated strongly with the total phenolics content (R^2=0.92246, R^2=0.88084, p<0.0001). Antioxidant power of green tea and bear berry tea was considerably higher than that of black tea. Raspberry and cherry showed the highest antioxidant power among fruit tea infusions. Contribution of phenolic compounds to tea antioxidant activity was also quantified in this study. Stepwise linear regression demonstrated that quantification of different phenolic compounds responsible for tea antioxidant activity was dependent on the method used. Gallic acid, caffeic acid (+)-catechin, (-)-epicatechin, (-)-epigallocatechin, procyanidin B1, procyanidin B2 together made up 43.6%-99.9% of the antioxidant activity of tea.

Antiradical activity was measured with the use of two different methods of scavenging the stable free radicals ABTS+• and DPPH•. Examined tea extracts showed different antiradical activity. Best activity in scavenging ABTS+• expressed as TAA (Total Antioxidant Activity) showed black tea aqueous and ethanol extracts. Green tea extracts were four times less effective. Antiradical activity showed that the lowest concentration needed to scavenge the 50% of initial DPPH• radical (EC50) was green and black tea ethanol extracts. Aqueous extracts showed 50% lower activity than equivalent ethanol extracts. Research proved that antiradical activity of plant extracts is dependent on mechanisms of oxidative activity of free radicals used and the chemical structure of contained antioxidants.

Tea is one of the common beverages used worldwide. Green tea is a commonly used beverage in the Asian countries. Tea contains constituents such as flavonoids and catechins which have wide use in several health related problems. Green tea extract catechins have four main derivatives: Epicatechin, Epigallocatechin (EGC), epicatechin gallate and EGC gallate. These constituents have a wide range of health benefits in varied degrees, some effects of which are dosage dependent and some are not dosage dependent. Several studies provide evidence that green tea catechins have the following beneficiary effects on human body fights cancer, lowers cholesterol, protection against heart disease, prevents diabetes, maintains a healthy circulatory system, prevents food poisoning, gives a healthier skin and acts as a potent detoxifier. It prevents cavities, strengthens tooth enamel, reduces plaque and bacteria and prevents bad breath in the oral cavity. This article reviews the antitumerigenic, antithrombotic, antiviral, antidiabetic, antioxidant activities and anticariogenic, antifungal activity, effect on periodontal disease and halitosis in the oral cavity.

To quickly evaluate the antioxidant activity of tea catechins Epicatechin (EC), Epigallocatechin (EGC), Epicatechingallate (ECG) and Epigallocatechinsgallate (EGCG), a semi empiric quantum chemistry calculation methods were employed to calculate many parameters, such as molecular geometry, heat of

formation (ΔfH), pKa, mulliken charges, electrostatic potential, bond dissociation enthalpy (ΔdH), orbital's energy difference (Egap), ovality, polarizability and Polar Surface Area (PSA). Among calculated parameters only heat of formation (ΔfH), bond dissociation energy (ΔdH) and Polar Surface Area (PSA) were correlated well with the antioxidant activity TEAC and DPPH values and give excellent correlation coefficients of 0.95, 0.98 and 0.94 successively. The results of such cheaper calculations can suitably scaled for predictive purpose.

Malathion is an organophosphate pesticide which is widely used in agriculture, veterinary and industries. Oxidative stress has been identified as one of malathion's main molecular mechanisms of action in plasma, liver, pancreas, muscles and the brain. Green tea (*Camellia sinensis*), which is the most common drink across the world after water, has many antioxidant properties. The purpose of this research is to investigate the effects of malathion on the liver and the preventive effects of green tea on malathion induced poisoning. Seventy two wistar male rats were randomly divided into the control, the sham, and the experimental groups (receiving respectively 40 mg/kg of malathion; 100 mg/kg, 200 mg/kg and 400 mg/kg of green tea; and 100 mg/kg, 200 mg/kg and 400 mg/kg of malathion and green tea respectively). All injections were performed intraperitoneally for 14 consecutive days. On the 15th day, blood samples were taken from the hearts of the rats to measure serum level of hepatic enzymes and their liver tissues were removed to be studied. To do the statistical analysis one way ANOVA test and Duncan's test at the 5% significance level were used. Aspartate Transaminase (AST), Alanine Transaminase (ALT), Alkaline Phosphatase (ALP), Malondialdehyde (MDA) and Total Oxidation Capacity (TOC) concentrations in the treatment groups with malathion and green tea extract at 100 mg/kg, 200 mg/kg and 400 mg/kg doses showed a significant decline compared to the malathion group ($p<0.05$), while Total Antioxidant Capacity (TAC) level showed a significant increase with various doses of green tea and malathion compared to the malathion group ($p<0.05$). Green tea, probably due to its strong antioxidant properties, could improve the destructive effects of malathion on the rat liver.

Different types of commercial tea samples were assayed to determine their phenolic composition and antioxidant activity. Reverse phase high performance liquid chromatography using a binary gradient system was used for the identification and quantification of individual catechins. Subsequently, total phenolic content was determined spectrophotometrically according to the Folin-ciocalteus method. Total theaflavins and thearubigins were also determined. The radical scavenging behavior of the polyphenols on 2,2-Diphenyl-1-Picrylhydrazyl radical (DPPH) was also studied spectrophotometrically. The results showed that total polyphenols, total catechins and antioxidant activity were significantly ($P<0.05$) different in the commercial tea samples. Green tea had the highest levels of catechins, total polyphenols and total antioxidant activity. White tea (silvery tip) a rare specialty type of tea was not significantly different from green tea. Statistical analysis showed an essential catechin content influence of the tea extracts on antioxidant activity. Epigallocatechin Gallate (EGCG) was the most potent catechin and the most potent in antioxidant activity ($r=0.989^{***}$). Epigallocatechin (EGC) ($r=0.787$, $P<0.001$), Epicatechin (EC) +catechin (+C) and Epicatechigallate (ECG) also showed significa nt ($P<0.05$) antioxidant activity. Black tea contained high levels of theaflavins and thearubigins, which accounted for most of the antioxidant potential in this type of tea product ($r=0.930^{***}$ and $r=0.930^{***}$ respectively). These results suggest that conversion of catechins during black tea processing did not affect the free radical potency of black tea. Gallic Acid (GA) also showed significant ($r=0.530^{*}$) contribution to the antioxidant activity in black tea. Green, black and white tea products processed from kenyan tea cultivars originally selected for black tea had significantly ($P<0.05$) higher antioxidant activity than green tea processed from tea cultivars from Japan and China. These results seem to suggest that the cultivar type is critical in determining the antioxidant potency of tea product and that black teas processed from suitable cultivars could be potent in antioxidant activity when compared to green teas.

Conclusion

The present review was very enlightening because many new facts have come up from the literature collected. A lot of research has been conducted on the different aspects of tea. Tea as we know is the most widely used beverage on earth. The use of tea dates back to almost 3000 years. The review of many scientific articles about tea justifies its use since thousands of years. Tea is used in different forms as tea powder, green tea, yellow tea, white tea etc. It is primarly used for its antioxidant property and CNS stimulant activity.

The chief chemical constituents responsible for the activity are caffeine (purine alkaloid) responsible for its CNS stimulant activity, it also contains tannins, epigallocatechin-3-gallate etc which are the compounds responsible for its reported pharmacological activity. The presence of polyphenols in tea also support the presence of antioxidant property of tea leaves.

Various articles have reported the anti inflammatory and antimicrobial activity apart from the antioxidant activity. The total phenolic content of tea can be estimated by folin ciocalteau reagent. Fermented teas also have better antioxidant properties. Antioxidant activity can estimated by DPPH radical scavenging assay or ABTS radical scavenging assay to estimate the antioxidant potential of different types of teas. The different extraction methods that can be used to extract the active principles of tea are namely infusion or decoction.

The various solvent extracts of tea can be taken and their antioxidant property can be compared by DPPH radical scavenging assay or ABTS radical scavenging assay. From this review I have understood that there is lot of scope of further research. There are many unexplored aspects of tea yet to be studied. Many research projects can be conducted on tea to compare the antioxidant activities of different types of tea namely green tea, yellow tea, red tea etc. Pharmacological studies of the volatile oil constituent of tea namely tea tree oil can be studied. The review was conducted to asses the work done on the phytochemicals present in tea and to asses the work done on the phytochemicals present in tea and to asses the different repoted pharmacological activities of Thea sinensis plant.

Hence the review was very insightful in understanding about how much work has been done on tea and to assws the future scope of research in tea.

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