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Review Article

Biological Effects of Tea Polyphenols on Human Health: A Review

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Abstract

Tea is the second most widely consumed beverage in the world, with only water being more common. There are many different types of teas available today, most of which have wonderful health benefits. Different types of tea, such as white tea, green tea, yellow tea, black tea, oolong tea and pu-erh tea, all come from the same plant, *Camellia sinensis*. The type of tea produced from this plant depends entirely on the way the leaves are processed after harvesting. . Many of these beneficial effects of tea are related to its polyphenolic contain Catechin, particularly (-)-epigallocatechin-3-gallate, content. The health benefits of tea for a wide variety of ailments, including different types of cancer, heart disease, liver and kidney disease, Kidney were reported there is evidence from *in vitro* and animal studies on the underlying mechanisms of tea catechins and their biological actions. There are also human studies on using tea catechins to treat metabolic syndrome, such as obesity, type II diabetes, and cardiovascular risk factors. Long-term consumption of tea catechins could be beneficial against high-fat diet-induced obesity and type II diabetes and could reduce the risk of coronary disease. Further research that conforms to international standards should be performed to monitor the pharmacological and clinical effects of tea and to elucidate its mechanisms of action.

Keywords: Tea polyphenol, Biological variation, Purpose of utilization, Metabolic syndrome

INTRODUCTION

In recent years, the health benefits of consuming green tea, including the prevention of cancer ancardiovascular diseases the anti-inflammatory, antiarthritic, antibacterial and antiangiogenic antioxidative, antiviral, neuroprotective, and cholesterol-lowering effects of green tea and isolated green tea constituents are under investigation (Agarwal et al., 1993). However, adding green tea to the diet may cause other serious health concerns. The health-promoting effects of green tea are mainly attributed to its polyphenol content, particularly flavanols and flavonols, which represent 30% of fresh leaf dry weight. Recently, many of the aforementioned beneficial effects of green tea were attributed to its most abundant catechin, (-)-Epigallocatechin-3-Gallate (EGCG) (Alessio et al., 2003). Green tea extracts are more stable than pure epigallocatechin gallate, one of the major constituents of green tea, because of the presence of other antioxidant constituents in the extract. In general, herbal medicines are complex mixtures of different compounds that often act in a synergistic fashion to exert their full beneficial effect (Aquilano et al., 2008).

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However, relatively few herbal medicines have been well characterized and their efficacy demonstrated in systematic clinical trials as compared to Western drugs.

This review article highlights the recent research on the efficacy, action mechanisms, and side effects of green tea and its catechins in *in vitro*, *in vivo*, and *ex vivo* systems.

LITERATURE REVIEW

Different type of tea

White tea: The least processed form of tea, picked from the first buds and thus the rarest and most expensive. As the leaves are very delicate, the tea is prepared at the lowest temperatures.

Green tea is made from the unfermented leaves of *Camellia sinensis* by quick drying, and thus has limited amounts of tannin. It is produced in China, Japan, Sri Lanka (Ceylon).

Oolong tea is a traditional Chinese tea (*Camellia sinensis*) produced through a unique process including withering under the strong sun and oxidation before curling and twisting (Aviram et al., 2000).

Most oolong teas, especially those of fine quality, involve unique tea plant cultivars that are exclusively used for particular varieties. The degree of fermentation can range from 8%.

Black tea: which is fully oxidized, contains about 10%-20% thearubigens; other elements include theaflavins (1%-2%). The full oxidation process also changes the chemical elements and one result is the creation of bisflavanols, a result from the flavanols undergoing polyphenol oxidative polymerization and oligomers (Babu et al., 2006).

Black tea is a type of tea that is more oxidized than oolong, green and white teas. Black tea is generally stronger in flavor than the less oxidized teas (Figure 1) (Bruneton, 2001).

Figure 1. Different Type of teas.

DISCUSSION

All four types are made from leaves of the shrub (or small tree) *Camellia sinensis*. Two principal varieties of the species are used the small-leaved Chinese variety plant (*C. sinensis subsp. sinensis*), used for most other types of teas, and the large-leaved.

Assamese plant (*C. sinensis subsp. assamica*), which was traditionally mainly used for black tea, although in recent years some green and white have been produced (Figure 2).

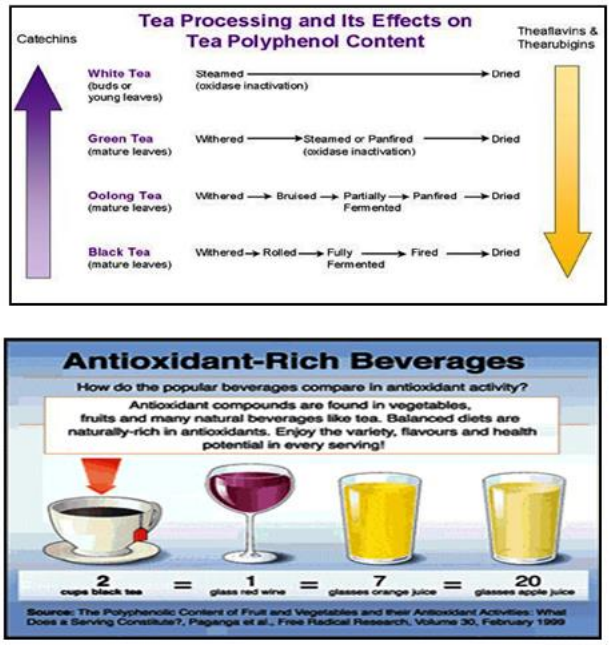

Figure 2. Tea processing effects on the tea polyphenolic content.

Phytochemistry of tea

The chemical composition of tea is complex: proteins (15%-20% dry weight), Poly whose enzymes constitute an important fraction; amino acids (1%-4% dry weight) such as theanine or 5-N ethylglutamine, glutamic acid, tryptophan, glycine, serine, aspartic acid, tyrosine, valine, leucine, threonine, arginine, and lysine; carbohydrates (5%-7% dry weight) such as cellulose, pectins, glucose, fructose, and sucrose; minerals and trace elements (5% dry weight) such as calcium, magnesium, chromium, manganese, iron, copper, zinc, molybdenum, selenium, sodium, phosphorus, cobalt, strontium, nickel, potassium, fluorine, and aluminum; and trace amounts of lipids (linoleic and a-linolenic acids), sterols (stigmasterol), vitamins (B, C, E), xanthic bases (caffeine, theophylline), pigments (chlorophyll, carotenoids), and volatile compounds (aldehydes, alcohols, esters, lactones, hydrocarbons) (Cabrera et al., 2006).

Due to the great importance of the mineral presence in tea, many studies have determined their levels in tea leaves and their infusions. Fresh leaves contain, on average, 3%-4% of alkaloids known as methylxanthines, such as caffeine, theobromine, and theophylline. In addition, there are phenolic acids such as gallic acids and characteristic amino acid such as theanine present. Tea Poly phenolic contains polyphenols, which include flavanols, flavandiols, flavonoids, and phenolic acids; these compounds may account for up to 30% of the dry weight. Most of the tea polyphenols (GTPs) are flavonols, commonly known as catechins, epicatechin, gallocatechin, and epigallocatechin (Figure 3).

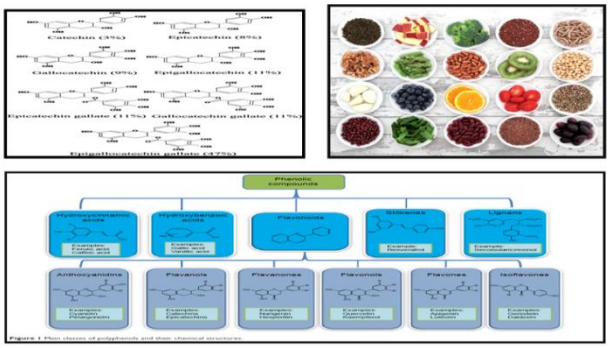

Figure 3. Type of polyphenol and sources from different colouring part of plant.

Type of tea and it's purposes of utilization

White tea: White tea is one of the more popular teas today because of its naturally light and sweet flavor. Other varieties, such as green tea, have a natural bitterness and require some sweeteners to be palatable for some people. Antioxidants: Interestingly, green, black and white teas are all made from the same type of plant. The differences in the teas come from the way in which the plants leaves are processed. With white teas, leaves are processed the least, which allows them to have the more antioxidants than green and black teas (although green teas are not far behind in antioxidant content) (Chen et al., 2007).

Cancer prevention: Some of the antioxidants in white tea have been found to have cancer-preventing properties. Examples of types of cancer which white tea may help prevent are lung, colon and skin cancer. Antibacterial and antiviral: White tea has also been found in some studies to have antibacterial and antiviral health benefits, so it may help you stay healthy and have a strong immune system. Low caffeine levels: In addition to having more antioxidants, white tea also beats out green and black teas when it comes to low levels of caffeine. This is a definite benefit for those who don't want to consume too much caffeine or who want something to drink later in the day without it keeping them awake at night.

Green tea: Green tea is one of the most common types of teas on the planet. It has numerous health benefits, including: Heart health: This tea has been found to effectively lower levels of triglycerides and cholesterol in the body. Many studies also suggest that green tea helps prevent atherosclerosis.

Cancer prevention: It's likely that the polyphenols in green tea are the reason this drink is useful for cancer prevention these substances are thought to inhibit the growth of cancer cells. Though studies are still ongoing in this area, green tea has been linked to

reduced risk of several types of cancer, including skin cancer, pancreatic cancer, lung cancer, prostate cancer and breast cancer. Weight loss: Studies have found that green tea extract can boost metabolism to help the body burn fat. This is thought to be a result of substances called catechins, which are found in the tea. Diabetes prevention and treatment: Because it can be used to control blood sugar, green tea has been used to help prevent and slow the progression of type 1 diabetes. Antioxidants: The antioxidants in this type of tea are helpful for warding off aging and cellular damage (Chen et al., 2001).

Black tea

Much like green tea, black tea is great for your heart. Here are some of black tea's key health benefits: Heart health: One of the biggest reasons to consider adding some black tea to your diet is the fact that it has been found to reduce the risk of heart attacks by 11 percent when three cups per day are consumed. On top of that, it has even more heart-healthy benefits. For example, black tea also helps lower cholesterol and triglyceride levels. Healthy blood vessels: Black tea contains flavonoids that are useful for protecting blood vessels from inflammation. This also helps prevent blood clotting. Antioxidants: Black tea also has a considerable amount of antioxidants, which can help fight against free radicals that lead to aging and cellular damage (Chen et al., 1998).

Oolong tea

Oolong tea is also popular for its many health benefits, which include: Weight loss: This particular type of tea has been found in several studies to help people lose weight. In one study, 66% of overweight individuals lost weight by drinking oolong tea daily for six weeks straight. Due to this fact, it is becoming more popular among those who are looking for healthy and natural ways to drop a few pounds. Cavity prevention: Oolong tea contains significant levels of fluoride, which is needed to help prevent dental cavities from forming (Figure 4).

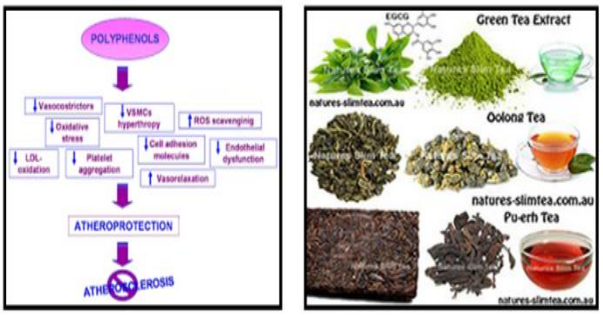

Figure 4. Biological role of polyphenol in different type of tea.

Possible health risks of teas

There are a few things to keep in mind if you want to get the most health benefits out of your teas.

First, remember that drinking tea with added sweeteners could reduce the health effects of drinking that particular type of tea. In addition, prepackaged tea drinks don't always have the same effects when it comes to health benefits. For the best results, brew pure preparations of the tea and avoid adding extra sweeteners. Second, avoid any teas that are used for crash diets or extreme weight loss. Teas aren't intended to have these health effects so products with these claims likely have added substances or chemicals with unknown health effects.

Mechanisms of biological effects of tea: Because tea consumption has been shown to have protective effects against a variety of diseases, defining the mechanisms of the biological effects of tea is important. In addition, elucidation of mechanisms may provide additional opportunities to intervene at other targets. Initial mechanistic studies regarding the cancer chemo preventive effects of green tea or its polyphenols largely focused on 1) protection against mutagenicity and genotoxicity, 2) inhibition of biochemical markers of tumor initiation, 3) inhibition of biochemical markers of tumor promotion, 4) effects on detoxification enzymes, 5) trapping of activated metabolites of carcinogens and 6) antioxidant and free radical scavenging activity.

Novel mechanistic work to define the anticarcinogenic effects of polyphenolic extracts from green tea and its constituents has been pursued; recent advances in this area are described in the following sections.

Health benefits of tea in humans and animals

Studies using animal models show that green tea catechins provide some protection against degenerative diseases. Some studies indicated that green tea has an ant proliferative activity on hepatoma cells and a hypolipidemic activity in hepatoma-treated rats, as well as the prevention of hepatoxicity and as a preventive agent against mammary cancer post-initiation (Costa et al., 2002).

Green tea catechins could also act as antitumorigenic agents and as immune modulators in immunodysfunction caused by transplanted tumors or by carcinogen treatment. Moreover, green tea, its extract, and its isolated constituents were also found to be effective in preventing oxidative stress and neurological problems.

Green tea consumption has also been linked to the prevention of many types of cancer, including lung. Colon, esophagus, mouth, stomach, small intestine, kidney, pancreas, and mammary glands. Several epidemiological studies and clinical trials showed that green tea (and black and Oolong teas to a lesser extent) may reduce the risk of many chronic diseases (Figure 5) (Dai et al., 2006).

Figure 5. Image showing *Stevia rebaudiana*.

This beneficial effect has been attributed to the presence of high amounts of polyphenols, which are potent antioxidants. In particular, green tea may lower blood pressure and thus reduce the risk of stroke and coronary heart disease. Some animal's studies suggested that green tea might protect against the development of coronary heart disease by reducing blood glucose levels and body weight. However, all these data are based on middle-aged animals' populations, not the elderly populations, which nutritional status tends to be more adversely influenced by age-related biological and socioeconomic factors (Figures 6 and 7).

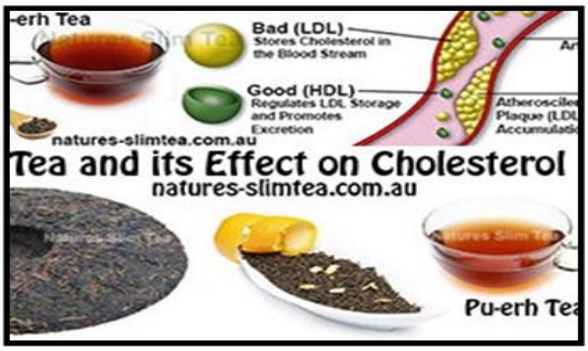

Figure 6. Image showing tea an effect on cholesterol.

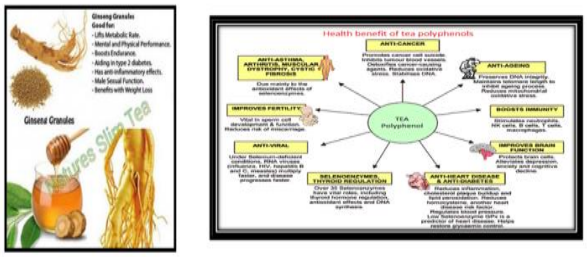

Figure 7. Health benefit of tea polyphenol in human cell.

Tea polyphenol and human diseases: Epidemiological studies have repeatedly shown an inverse association between the risk of chronic human diseases and the consumption of polyphenolic rich diet and beverages. The phenolic groups in polyphenols can accept an electron to form relatively stable phenoxyl radicals, there by disrupting chain oxidation reactions in cellular components. It is well established that polyphenol-rich foods and beverages may increase plasma antioxidant capacity. This increase in the antioxidative capacity of plasma following the consumption of polyphenol-rich food may be explained either by the presence of reducing polyphenols and their metabolites in plasma, by their effects upon concentrations of other reducing agents (sparing effects of polyphenols on other endogenous antioxidants), or by their effect on the absorption of pro-oxidative food components, such as iron. Consumption of antioxidants has been associated with reduced levels of oxidative damage to lymphocytic DNA. Similar observations have been made with plyphenol-rich food and beverages indicating the protective effects of polyphenols. There are increasing evidences that as antioxidants, polyphenols may protect cell constituents against oxidative damage and, therefore, limit the risk of various degenerative diseases associated with oxidative stress (Dembinska-Kiec et al., 2008).

Cancer protective effect tea polyphenol: Effect of polyphenols on human cancer cell lines, is most often protective and induce a reduction of the number of tumors or of their growth.These effects have been observed at various sites, including mouth, stomach, duodenum, colon, liver, lung, mammary gland or skin. Many polyphenols, such as quercetin, catechins, isoflavones, lignans, flavanones, ellagic acid, red wine polyphenols, resveratrol and curcumin have been tested; all of them showed protective effects in some models although their mechanisms of action were found to be different. oxidative medicine and cellular longevity and development of cancer or carcinogenesis is a multistage and micro volutionary process. Into the three major stages of carcinogenesis: initiation, promotion and progression. Initiation is a heritable aberration on a cell. Cells so initiated can undergo transformation to malignancy if promotion and progression follow. Promotion, on the other hand, is affected by factors that do not alter DNA sequences and involves the selection and clonal expansion of initiated cells several mechanisms of action have been identified for chemoprevention effect of polyphones, these include estrogenic/anties Several mechanisms of action have been identified for chemoprevention. Effect of polyphenols, these include estrogenic/antiestrogenic activity, antiproliferation, induction of cell cycle arrest or apoptosis, prevention of oxidation, induction of detoxification enzymes.

Regulation of the host immune system, anti-inflammatory activity and changes in cellular signaling.

Green tea induces apoptosis and cell cycle arrest: In recent years, apoptosis has become a challenging area of biomedical research. The life spans of both normal and cancer cells within living systems are thought to be significantly affected by the rate of apoptosis, a programmed type of cell death that differs from necrotic cell death and is regarded as a normal process of cell elimination. It follows that the chemopreventive agents that can modulate apoptosis and thereby affect the steady state cell population may be useful in the management and therapy of cancer. Many cancer-chemopreventive agents induce apoptosis and, conversely, several tumor promoters inhibit apoptosis. It is reasonable, therefore, to assume that chemo preventive agents that have proven effects in animal tumor bioassay systems or human epidemiologic studies on the one hand and that induce apoptosis of cancer cells on the other hand may have wider implications for the management of cancer. Only a few chemopreventive agents are known to cause apoptosis, however. We found that EGCG induced apoptosis and cell cycle arrest in human epidermoid carcinoma cells A431. Importantly, we also found that the apoptotic response of EGCG was specific to cancer cells, because the induction of apoptosis was also observed in human carcinoma keratinocytes HaCaT, human prostate carcinoma cells DU145, and mouse lymphoma cells LY-R but not in normal human epidermal keratinocytes (Figure 8).

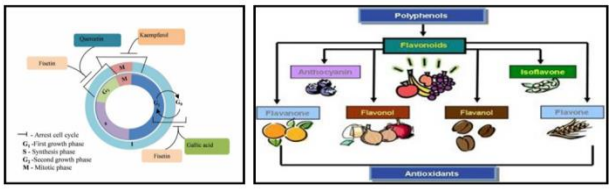

Figure 8. Polyphenol cell cycle arrest and acts as antioxidant and anticancer.

EGCG and theaflavins inhibit tumor promoter-induced activator protein 1 activation and cell transformation: To examine antitumor promotion effects of EGCG and theaflavins at the molecular level, used a JB6 mouse epidermal cell line, a system that has been used extensively as an *in vitro* model for tumor promotion studies. EGCG and theaflavins inhibited EGF- or 12-O-tetradecanoyl-phorbol-13-acetate–induced cell transformation in a dose-dependent manner. EGCG and theaflavins also inhibited activator protein 1 (AP-1)-dependent transcriptional activity and DNA binding activity. Finally, this study showed that the inhibition of AP-1 activation occurs through the inhibition of a pathway dependent on c-Jun N-terminal kinase. EGCG and theaflavins inhibit tumor promoter-induced activator protein 1 activation and cell transformation. To examine antitumor promotion effects of EGCG and theaflavins at the molecular level, used a JB6 mouse epidermal cell line, a system that has been used extensively as an *in vitro* model for tumor promotion studies. EGCG and theaflavins inhibited EGF- or 12-O-tetradecanoyl-phorbol-13-acetate induced cell transformation in a dose-dependent manner. EGCG and theaflavins also inhibited activator protein 1 (AP-1)-dependent transcriptional activity and DNA binding activity. Finally, this study showed that the inhibition of AP-1 activation occurs through the inhibition of a pathway dependent on c-Jun N-terminal kinase.

Cradio-protective effect of tea polyphenol: Number of studies has demonstrated that consumption of tea polyphenols limits the incidence of coronary heart diseases. Atherosclerosis is a chronic inflammatory disease that develops in lesion-prone regions of medium-sized arteries. Atherosclerotic lesions may be present and clinically silent for decades before becoming active and producing pathological conditions such as acute myocardial infarction, unstable angina or sudden cardiac death. Polyphenols are potent inhibitors of LDL oxidation and this type of oxidation is considered to be a key mechanism in development of atherosclerosis. Other mechanisms by which Polyphenols may be protective against cardiovascular diseases are antioxidant, anti-platelet, anti-inflammatory effects as well as increasing HDL, and improving endothelial function. Quercetin, the abundant polyphenol in onion has been shown to be inversely associated with mortality from coronary heart disease by inhibiting the expression of Metalloproteinase 1 (MMP1), and the disruption of atherosclerotic plaques. Tea catechins have been shown to inhibit the invasion and proliferation of the smooth muscle cells in the arterial wall, a mechanism that may contribute to slow down the formation of the atheromatous lesion. Polyphenols may also exert antithrombotic effects by means of inhibiting platelet aggregation. Consumption of red wine or non-alcoholic wine reduces bleeding time and platelet aggregation. tea polyphenols reduced the risk of coronary heart disease (Figure 9).

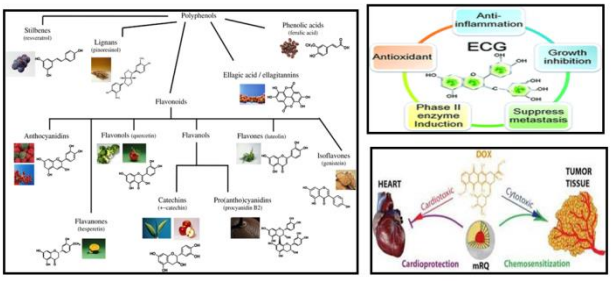

Figure 9. Polyphenol help to cardiac protection via prevent oxidation of LDL.

Antiinflammatory effects of tea: In several studies from our laboratory and elsewhere, the polyphenolic fraction from green tea was shown to protect against inflammation caused by certain chemicals, such as 12-O-tetradecanoylphorbol-13-acetate, a principal irritant in croton oil (2, 19, 20), or by ultraviolet radiation B (290 nm-320 nm) . Green tea has also been shown to be effective against the immunosuppressant caused by ultraviolet radiation B. In addition, green tea polyphenols have shown protection against cytokines induced by tumours. Because tea consumption has been shown to have protective effects against a variety of diseases, defining the mechanisms of the biological effects of tea is important. In addition, elucidation of mechanisms may provide additional opportunities to intervene at other targets. Initial mechanistic studies (reviewed in reference 2) regarding the cancer chemo preventive effects of green tea or its polyphenols largely focused on 1) protection against mutagenic- ity and genotoxicity, 2) inhibition of biochemical markers of tumor initiation, 3) inhibition of biochemical markers of tumor promotion, 4) effects on detoxification enzymes, 5) trapping of activated metabolites of carcinogens and 6) antioxidant and free radical scavenging activity. Novel mechanistic work to define the anticarcinogenic effects of polyphenolic extracts from green tea and its constituents has been pursued; recent advances in this area are described in the following sections (Dona et al., 2003).

Antioxidant effect of tea polyphenol: Effects on antioxidant markers and oxidative stress green tea is a popular neutraceutical as an antioxidant. Antioxidants are compounds that protect cells against the damaging effects of reactive oxygen species, such as singlet oxygen, superoxide, peroxyl radicals, hydroxyl radicals, and peroxynitrite. An imbalance between antioxidants and reactive oxygen species results in oxidative stress, leading to cellular damage. Catechins are hypothesized to help protect against these diseases by contributing, along with antioxidant vitamins (*i.e.,* vitamins C and E) and enzymes (*i.e.,* superoxide dismutase and catalase), to the total antioxidant defense system (Dulloo et al., 2000).

Effect tea poly phenol on obesity:

The effects of tea on obesity and diabetes have received increasing attention. Tea catechins, especially EGCG, appear to have antiobesity and antidiabetic effects. African black tea extract has been shown to suppress the elevation of blood glucose during food intake and reduce the body weight diabetic mice. Although few epidemiological and clinical studies have shown the health benefits of EGCG on obesity and diabetes, the mechanisms of its actions are emerging based on various laboratory data. These mechanisms may be related to certain pathways, such as through the modulations of energy balance, endocrine systems, food intake, lipid and carbohydrate metabolism, and redox status. A double-blind, placebo-controlled, cross-over design study showed that consumption of a beverage containing green tea catechins, caffeine, and calcium increases 24-h energy expenditure by 4.6%, but the contribution of the individual ingredients could not be distinguished. It was suggested that such modifications were sufficient to prevent weight gain. It has been reported that the body weights frats and their plasma triglyceride, cholesterol, and low-density lipoprotein cholesterol were significantly reduced by feedings of Oolong, black, and green tea leaves to the animals. In addition, the inhibition of growth and suppression of biogenesis in MCF-7 breast cancer cells may be through down-regulation of fatty acid synthase gene expression in the nucleus and stimulation of cell energy expenditure in the mitochondria. When fed to mice, EGCG purified from green tea decreased diet-induced obesity in mice by decreasing energy absorption and increasing fat oxidation. The increased and prolonged sympathetic stimulation of thermogenesis by the interaction between polyphenols and caffeine could be of value in assisting the management of obesity (Figure 10).

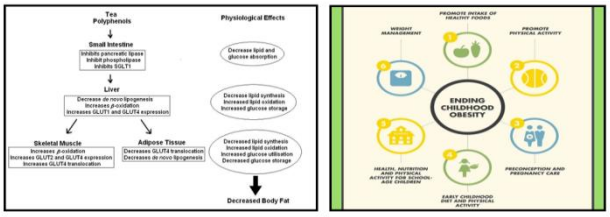

Figure 10. Polyphenol help to control obesity.

Tea polyphenol in anti-diabetics: Impairment in glucose metabolism leads to physiological imbalance with the onset of the hyperglycemia and subsequently diabetes mellitus. There are two main categories of diabetes; type-1 and type-2. Studies have shown that several physiological parameters of the body get altered in the diabetic conditions. Long term effects of diabetes include progressive development of specific complements such as retinopathy, which affects eyes and lead to blindness; nephropathy in which the renal functions are altered or disturbed and neuropathy which is associated with the risks of amputations, foot ulcers and features of autonomic disturbance including sexual dysfunctions. Numerous studies report the antidiabetic effects of polyphenols. Tea catechins have been investigated for their anti-diabetic potential. Polyphenols may affect glycemia through different mechanisms, including the inhibition of glucose absorption in the gut or of its uptake by peripheral tissues. The hypoglycemic effects of diacetylated anthocyanins at a 10 mg/kg diet dosage were observed with maltose as a glucose source, but not with sucrose or glucose (Fesus et al., 1995).

This suggests that these effects are due to an inhibition of α-glucosidase in the gut mucosa. Inhibition of α-amylase and sucrase in rats by catechin at a dose of about 50 mg/kg diet or higher was also observed. The inhibition of intestinal glycosidases and glucose transporter by polyphenols has been studied. Individual polyphenols, such as (+)catechin, (-)epicatechin, (-)epigallocatechin, epicatechin gallate, isoflavones from soyabeans, tannic acid, glycyrrhizin from licorice root, chlorogenic acid and saponins also decrease S-Glut-1 mediated intestinal transport of glucose. Saponins additionally delay the transfer of glucose from stomach to the small intestine. Resveratrol has also been reported to act as an anti-diabetic agent. Many mechanisms have been proposed to explain the anti-diabetic action of this stilbene, modulation of SIRT1 is one of them which improves whole-body glucose homeostasis and insulin sensitivity in diabetic rats. It is reported that in cultured LLC-PK1 cells, high glucose induced cytotoxicity and oxidative stress was inhibited by grape seed polyphenols. Resveratrol inhibits diabetes-induced changes in the kidney (diabetic nephropathy) and significantly ameliorates renal dysfunction and oxidative stress in diabetic rats. Treatment with resveratrol also decreased insulin secretion and delayed the onset of insulin resistance. A possible mechanism was thought to be related to the inhibition of K + ATP and K + V channel in beta cells (Figure 11) (Garcia-Lafuente et al., 2009).

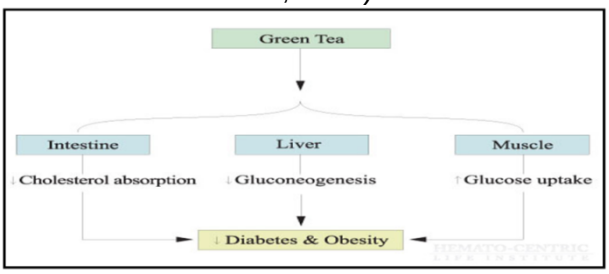

Figure 11. Green tea Polyphenol help to control diabetes and obesity.

Anti-aging effect of tea polyphenol: Aging is the accumulation process of diverse detrimental changes in the cells and tissues with advancing age, resulting in an increase in the risks of disease and death. Among many theories purposed for the explaining the mechanism of aging, free radical/oxidative stress theory is one of the most accepted one. A certain amount of oxidative damage takes place even under normal conditions; however, the rate of this damage increases during the aging process as the efficiency of antioxidative and repair mechanisms decrease. Antioxidant capacity of the plasma is related to dietary intake of antioxidants; it has been found that the intake of antioxidant rich diet is effective in reducing the deleterious effects of aging and behavior. Several researches suggest that the combination of antioxidant/anti-inflammatory polyphenolic compounds found in fruits and vegetables may show efficacy as anti-aging compounds. Subset of the flavonoids known as anthocyanins, are particularly abundant in brightly colored fruits such as berry fruits and concord grapes and grape seeds. Anthocyanins are responsible for the colors in fruits, and they have been shown to have potent antioxidant/anti-inflammatory activities, as well as to inhibit lipid peroxidation and the inflammatory mediators Cyclo-Oxygenase (COX)-1 and -2. Fruit and vegetable extracts that have high levels of flavonoids also display high total antioxidant activity such as spinach, strawberries and blueberries. It is reported that the dietary supplementations (for 8 weeks) with spinach, strawberry or blueberry extracts in a control diet were also effective in reversing age-related deficits in brain and behavioural function in aged rats. A recent study demonstrates that the tea catechins carry strong anti-aging activity and consuming green-tea rich in these catechins, may delay the onset of aging. Polyphenols are also beneficial in ameliorating the adverse effects of the aging on nervous system or brain. Paramount importance for the relevance of food polyphenols in the protection of the aging brain is the ability of these compounds to cross the Blood-Brain Barrier (BBB), which tightly controls the influx in the brain of metabolites and nutrients as well as of drugs. Resveratrol has been found to consistently prolong the life span; its action is linked to an event called caloric restriction or partial food deprivation.

Neuroprotective effect of tea poly phenol: Oxidative stress and damage to brain macromolecules is an important process in Neurodegenerative diseases. Alzheimer's disease is one of the most common occurring neurodisorder affecting up to 18 million people worldwide. Because polyphenols are highly antioxidative in nature, their consumption may provide protection in neurological diseases. It was observed that the people drinking three to four glasses of wine per day had 80% decreased incidence of dementia and Alzheimer's disease compared to those who drank less or did not drink at all. Resveratrol, abundantly present in wine scavenges O *in vitro*, as well as lipid hydroperoxyl free radicals, this efficient antioxidant activity is probably involved in the beneficial effect of the moderate consume of red wine against dementia in the elderly. Resveratrol inhibits nuclear factor κ B signaling and thus gives protection against microglia-dependent β-amyloid toxicity in a model of Alzheimer's disease and this activity is related with the activation of the SIRT-1. It was found that the consumption of fruit and vegetable juices containing high concentrations of polyphenols, at least three times per week, may play an important role in delaying the onset of Alzheimer's disease. Polyphenols from fruits and vegetables seem to be invaluable potential agents in neuro protection by

virtue of their ability to influence and OH n by virtue of their ability to influence and modulate several cellular processes such as signaling, proliferation, apoptosis, redox balance and differentiation (Graf et al., 2005 and Hakim et al., 2000).

Adverse effects of green tea: Although green tea has several beneficial effects on health, the effects of green tea and its constituents may be beneficial up to a certain dose yet higher doses may cause some unknown adverse effects. Moreover, the effects of green tea catechins may not be similar in all individuals. EGCG of green tea extract is cytotoxic, and higher consumption of green tea can exert acute cytotoxicity in liver cells, a major metabolic organ in the body. Another study found that higher intake of green tea might cause oxidative DNA damage of hamster pancreas and liver. Yun et al. clarified that EGCG acts as a pro-oxidant, rather than an antioxidant, in pancreatic b cells *in vivo*. Therefore, high intake of green tea may be detrimental for diabetic animals to control hyperglycemia. At a high dose (5% of diet for 13 wk), green tea extract induced a thyroid enlargement (goitre) in normal rats. This high-level treatment modified the plasma concentrations of the thyroid hormones. However, drinking even a very high dietary amount of green tea would be unlikely to cause these adverse effects in humans. Harmful effects of tea overconsumption (black or green) are due to three main factors: 1) its caffeine content, 2) the presence of aluminum and 3) the effects of tea polyphenols on iron bioavailability.

Green tea should not be taken by patients suffering from heart conditions or major cardiovascular problems. Pregnant and breastfeeding women should drink no more than one or two cups per day, because caffeine can cause an increase in heart rhythm. It is also important to control the concomitant consumption of green tea and some drugs, due to caffeine's diuretic effects. Some studies revealed the capacity of tea plants to accumulate high levels of aluminium. This aspect is important for patients with renal failure because aluminum can be accumulated by the body, resulting in neurological diseases; it is therefore necessary to control the intake of food with high amounts of this metal. Likewise, green tea catechins may have an affinity for iron, and green tea infusions can cause a significant decrease of the iron bioavailability from the diet (Hamdaoui et al., 2003).

CONCLUSION

Studies on polyphenol from tea showed the health effects of green tea. As the human clinical evidence is still limited, future research needs to define the actual magnitude of health benefits, establishes the safe range of tea consumption associated with these benefits, and elucidates the mechanisms of action. Development of more specific and sensitive methods with more representative models along with the development of good predictive biomarkers will give a better understanding of how green tea interacts with endogenous systems and other exogenous factors. Definitive conclusions concerning the protective effect of green tea have to come from well-designed observational epidemiological studies and intervention trials. The development of biomarkers for green tea consumption, as well as molecular markers for its biological effects, will facilitate future research in this area. Dietary habits influence the risk of developing a variety of diseases, especially cancer and heart disease.

The use of dietary substances is receiving increasing attention as a practical approach for reducing the risk of developing these diseases. Epidermatologic observations and laboratory studies have indicated that tea consumption may have beneficial effects in reducing certain types of cancer in some populations. Although a considerable body of information provides evidence supporting the preventive potential of tea against cancer, a proper understanding of the mechanisms by which tea polyphenols reduce the risk of diseases is necessary to devise strategies for better health. Black tea is the major form of tea consumed, but its chemistry, biological activities, and chemo preventive properties, especially of the polyphenols that are present, are not well defined.

Because information on the bioavailability of tea polyphenols after tea consumption is limited in humans, studies on absorption, distribution, and metabolism of green and black tea polyphenols in animals and humans are needed. After careful evaluation of the available data and additional studies, specific recommendations may be made for consumption of tea by humans. The usefulness of tea polyphenols may be extended by combining them with other consumer products, such as food items and vitamin supplements. This "designer-item" approach may be useful for the human population.

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