

## CAMELLIA SINENSIS (L): THE MEDICINAL BEVERAGE: A REVIEW

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### ABSTRACT

*Camellia sinensis* is commonly known as Tea which is most consummated beverage in the world. The diversify properties of the *C.sinensis* encourage us for new research. There are lots of finding in process on the tea. And there are some positive aspects also found. Present review is an attempt to summarize the various pharmacological effects particularly anti cancer and antioxidant activity may be a powerful tool for future era. In this whole study we can see how much tea is beneficial and may be it will prove a good tool for better treatment option.

**Keywords:** *Camellia sinensis*, green tea, black tea, review.

### INTRODUCTION

*Camellia sinensis* (L.) (Theaceae) is commonly known as green tea in the India. *C.sinensis* is mainly cultivated in India (Assam) and china. Green tea has many beneficial effects on the body. So we analyze the various pharmacological effect of green tea. The recent era is all about herbal treatment of various diseases and green tea is one of the best tonic for healthy well being. Here, various important pharmacological actions has been summarized and concluded that, a simple tea for a layman has tremendous benefits as a medicine if taken into considerations.

#### Pharmacological activities:

##### Anti cancer activity<sup>1</sup>

The anticancer activity of di- and tri-terpenes and other polyphenol compounds present in tea is already reported. The cytotoxic and apoptogenic effect of tea root extract (TRE) and two of its steroidal saponins named as TS1 and TS2, on human cell lines and on cells from leukemia patients. It was found that TRE, TS1 and TS2 significantly decreased cell count and that TRE caused apoptosis, as confirmed morphologically by confocal microscopy and by flow-cytometric analysis using Annexin-V FITC and propidium iodide (PI). Cell count and MTT assay in normal white blood cells (WBC) of healthy volunteers revealed that TRE produced insignificant reduction in cell count and cytotoxicity.

##### Lipid lowering activity<sup>2</sup>

Tea supplemented with vitamin E, administered to male Syrian hamsters, reduced plasma low-density lipoprotein (LDL) cholesterol concentrations, LDL oxidation, and early atherosclerosis compared to the consumption of tea alone by the hamsters. The anti- oxidant action of vitamin E is through the incorporation of vitamin E into the LDL molecule. The hamsters were fed a semi purified hypercholesterolemic diet containing 12% coconut oil, 3% sunflower oil, and 0.2% cholesterol (control), control and 0.625% tea, control and 1.25% tea or control and 0.044% tocopherol acetate for 10 weeks. The hamsters fed the vitamin E diet compared to the different concentrations of tea significantly lower plasma LDL cholesterol

concentrations, -18% ( $p < 0.007$ ), -17% ( $p < 0.02$ ), and -24% ( $p < 0.0001$ ), respectively.

##### Anti carcinogenic activity<sup>3</sup>

Green tea extract, in human umbilical vein endothelial cells, did not affect cell viability but significantly reduced cell proliferation dose-dependently and produced a dose-dependent accumulation of cells in the gastrointestinal phase. The decrease of the expression of vascular endothelial growth factor receptors like tyrosinekinase and fetal liver kinase-I/ kinase insert domain containing receptor in the cell culture by the extract was detected with immunohistochemical and Western blot test.

##### Neuromuscular-blocking action<sup>4</sup>

Thearubigin fraction of black tea was investigated for neuromuscular-blocking action of botulinum neurotoxin types A, B, and E in the mouse phrenic nerve-diaphragm preparations. On binding, A (1.5 nM), B (6 nM) and E (5 nM) abolished indirect twitches within 50, 90, and 90 minutes, respectively Thearubigin fraction mixed with each toxin protected against the neuromuscular-blocking action of botulinum neurotoxin types AB, and E by binding with the toxins.

##### Immunomodulatory effect<sup>5</sup>

To determine the effects of tea on transplant-related immune function in vitro lymphocyte proliferation tests using phytohemagglutinin mixed lymphocytes culture assay, IL-2, and IL-10 production from mixed lymphocyte proliferation were performed. Tea had immunosuppressive effects and decreased alloresponsiveness in the culture. The immunosuppressive effect of tea was mediated through a decrease in IL-2 production.

##### DNA effect<sup>6</sup>

Green tea extract, in cell culture at a dose of 10 mg/L corresponding to 15 mmol/L EGCg for 24 hours, did not protect Jurkat cells against H<sub>2</sub>O<sub>2</sub>-induced DNA damage. The DNA damage, evaluated by the Comet assay, was dose-dependent. However, it reached plateau at 75 mmol/L of H<sub>2</sub>O<sub>2</sub> without any protective effect exerted by the extract. The DNA repair process, completed within 2 hours, was unaffected by supplementation.

**Antiviral activity<sup>7</sup>**

Epigallocatechin-3-gallate, administered to Hep2 cells in culture, produced a therapeutic index of 22 and an IC<sub>50</sub> of 25 PM. The agent was the most effective when added to the cells during the transition from the early to the late phase of viral infection suggesting that the polyphenol inhibits one or more late steps in virus infection.

**Antibacterial activity<sup>8</sup>**

Alcohol extract of black tea, assayed on *Salmonella typhi* and *Salmonella paratyphi A*, was active on all strains of *Salmonella paratyphi A*, and only 42.19% of *Salmonella typhi* strains were inhibited by the extract.

**Anti Spasmodic activity<sup>9</sup>**

Hot water extract and tannin fraction of the dried entire plant were active on the rabbit and rat intestines vs. pilocarpine-induced spasms and barium induced contractions.

**Anticataract activity<sup>10</sup>**

Tea, administered in culture to enucleated rat lens, reduced the incidence of selenite cataract in vivo. The rat lenses were randomly divided into normal, control and treated groups and incubated for 24 hours at 37°C. Oxidative stress was induced by sodium selenite in the culture medium of the two groups (except the normal group). The medium of the treated group was additionally supplemented with tea extract. After incubation, lenses were subjected to glutathione and malondialdehyde estimation. Enzyme activity of superoxide dismutase, catalase, and glutathione peroxidase were also measured in different sets of the experiment. *In vivo* cataract was induced in 9-day-old rat pups of both control and treated groups by a single subcutaneous injection of sodium selenite. The treated pups were injected with tea extract intraperitoneally prior to selenite challenge and continued for 2 consecutive days thereafter. Cataract incidence was evaluated on 16 postnatal days by slit lamp examination. There was positive modulation of biochemical parameters in the organ culture study. The results indicated that tea act primarily by preserving the antioxidant defense system.

**Antioxidant activity<sup>11</sup>**

Black tea leaves, administered to human red blood cells, was effective against damage by oxidative stress induced by inducers such as phenylhydrazine, Cu<sup>2+</sup>-ascorbic acid, and xanthine/xanthine oxidase systems. Lipid peroxidation of pure erythrocyte membrane and of whole red blood cell was completely prevented by black tea extract. Similarly, the tea provided total protection against degradation of membrane proteins. Membrane fluidity studies as monitored by the fluorescent probe 1, 6-diphenyl-hexa-1, 3, 5- triene showed considerable disorganization of its architecture that could be restored back to normal on addition of black tea or free catechins. The tea extract in comparison to free catechin seemed to be a better protecting agent against various types of oxidative stress.

**Antidiabetic activity<sup>12</sup>**

The aqueous green leaf extract of *Camellia sinensis* (450 mg kg<sup>-1</sup>) showed a strong glucose lowering effect after

oral administration in rats. The decrease of glycemia has reached to 30% of the control value 2h after glucose loading. The amount of glucose absorbed in a segment jejunum in situ was 9.2±0.2 mg in presence of tea extract vs. 14.11±0.91 mg in control rats during 2 h (p<0.05). The results indicate that aqueous extract of tea has a significant anti hyperglycemic effect that may be caused in part by the reduction of intestinal glucose absorption.

**Antigenotoxic effect<sup>13</sup>**

Tea is a rich source of polyphenol called flavonoids, effective antioxidants found throughout the plant kingdom. The slight astringent, bitter taste of green tea is attributed to polyphenol. A group of flavonoids in green tea are known as catechins, which are quickly absorbed into the body and are thought to contribute to some of the potential health benefits of tea. The fresh tea leaves contain four major catechins as colorless water soluble compounds. Epicatechin (EC), epicatechingallate (ECG), epigallocatechin (EGC) and epigallocatechin gallate (EGCG). Epidemiologic observations and laboratory studies have indicated that tea polyphenol act as antioxidants *in vitro* by scavenging reactive oxygen and nitrogen species and chelating redox active transition metal ions and hence tea may reduce the risk of a variety of illnesses, including cancer and coronary heart disease. In this study the antigenotoxic effect of green tea extract against genotoxic damage induced by two anabolic steroids Trenbolone and Methyltestosterone in cultured human lymphocytes, both in absence and presence of metabolic activation. The results prove the antigenotoxic potential of green tea extract. Because the epidemiologic studies and research findings in laboratory animals have shown the antigenotoxic potential of tea polyphenol, the usefulness of tea polyphenol for various human diseases like cancer and coronary heart disease etc should be evaluated in clinical trials.

**Hepatoprotective and antioxidant activity<sup>14</sup>**

Hepatoprotective and antioxidant effects of water extracts of black tea (*Camellia sinensis*) were studied in sodium oxalate treated rats. Lipid peroxidation was induced in rats by administration of 100 mg/kg body weight sodium oxalate. The protective effect of black tea was assessed by monitoring the serum and tissue levels of malondialdehyde, catalase activity, aspartate transaminase (AST) and alanine transaminase (ALT) as well as serum vitamin C content in the normal, control and experimental rats after 10 and 20 days of tea administration. It was observed that tea administration lowers significantly (p<0.05) the serum and tissue levels of malondialdehyde, as well as AST and ALT activities in a dose dependent manner. The serum level of vitamin C and activity of catalase in the serum and tissues were however shown to be significantly elevated (p<0.05). After 10 days of administration of 200 mg/kg body weight of tea extract, serum level of malondialdehyde was reduced from 47.855±1.050 to 32.186±0.882 nm/h, AST activity from 59±2.95 to 31±1.40 IU and ALT activity from 39±2.51 to 25±1.25 IU. Moreover, administration of 200 mg/Kg body weight of tea for 10 days caused an increase in serum catalase activity from 7 to 10% and serum vitamin C level was increased from

45.39±9.75 to 79.11±5.13 mg/100 ml. In the tissues, the same trend was observed. The result also indicated that prolonged tea administration (for 20 days) significantly increased serum vitamin C level and the activity of catalase in both the serum, liver and the kidney ( $p < 0.05$ ). Also, the serum and tissue levels of malondialdehyde and transaminase activities (AST and ALT) were significantly reduced ( $p < 0.05$ ).

#### Antibacterial effect in intestine<sup>15</sup>

The employment of *Camellia sinensis* (L.) whole plant extract as food supplement in livestock nutrition has been suggested in order to prevent usual livestock intestinal diseases. The aim of the present research was to test the effects of such plant extract on the composition of pig faecal microbiota. Preliminary *in vitro* fermentation trials evidenced in mixed pig faecal cultures, supplemented with the tested extract, an increase of total anaerobe ( $p = 0.02$ ) and aerobic ( $p = 0.03$ ) bacteria, and a decrease of *clostridia* ( $p = 0.04$ ) compared to control cultures. Afterwards we investigated *in vivo* the effects on piglet faecal microbiota of a diet added with 250 mg/kg of *Camellia sinensis* whole plant extract. A control diet without the plant extracts, but added with antibiotic (sulphadiazine, trimethoprim, and tiamulin) was used for the comparison. Microbiological analyses of faecal samples collected after 60 days of the experimental feeding, evidenced a decrease of *clostridia* ( $p = 0.001$ ) and *enterococci* ( $p = 0.04$ ) counts in the faeces of animals fed with the experimental diet, compared to those fed with the control diet. These results show that the *Camellia sinensis* (L.) whole plant extract is able to reduce the number of some potential pathogenic bacteria in piglet gut and hence might improve animal health.

#### Anti-inflammatory activity<sup>16</sup>

Pharmacological studies were carried out with methanol-water (1:1) extract of dried tea (*Camellia sinensis*) root extract (TRE). TRE was found to possess anti-inflammatory, analgesic and antipyretic activities at 1/10th of its LD<sub>50</sub> dose of 100 mg/kg i.p. It was found that TRE inhibited the arachidonic acid-induced paw oedema in rats which indicated that TRE produced the anti-inflammatory activity by inhibiting both the cyclooxygenase and lipoxygenase pathways of arachidonic acid metabolism. TRE also enhanced peritoneal cell count and the number of macrophages in normal mice. It is plausible that the saponins present in TRE may be responsible for these activities of TRE.

#### Effect on oxidative stress<sup>17</sup>

The protective action of aqueous black tea extract (BTE) against ovariectomy-induced oxidative stress of mononuclear cells and its associated progression of bone loss was demonstrated in this study. Eighteen female adult 6-month-old *Wistar albino* rats were divided into three groups: sham-control (A), bilaterally ovariectomized (B) and bilaterally ovariectomized + BTE supplemented (C). Studies included the measurement of oxidative (nitric oxide, lipid peroxidation) and antioxidative (superoxide dismutase, catalase) markers, inflammatory cytokines (IL-6, TNF- $\alpha$ ), osteoclast differentiation factor (RANKL) and bone resorption markers (tartrate-resistant acid phosphatase and hydroxyproline). Also quantitative

histomorphometry and histological studies were undertaken. The bone breaking force was measured. The results indicate that BTE was effective in preserving and restoring skeletal health by reducing the number of active osteoclasts. Such changes with BTE supplementation were steadily linked with the reduced oxidative stress of mononuclear cells, serum levels of bone resorbing cytokines, osteoclast differentiation factor and resorption markers. The results of the bone breaking force, histological and histomorphometric analyses further supported the hypothesis. This study suggests that BTE has both protective and restorative actions against ovariectomy-induced mononuclear cell oxidative stress and associated bone loss.

#### Chemoprotective activity<sup>18</sup>

Several herbal teas contain bioactive compounds that have been associated with a lower risk of chronic diseases including cancer. The aim of this study was to evaluate the chemopreventive activity of tea aqueous extracts and selected constituent pure polyphenols using a battery of *in vitro* marker systems relevant for the prevention of cancer. The effects of (–)epigallocatechin gallate (EGCG), quercetin (Q), gallic acid (GA), green tea (GT, *Camellia sinensis*), ardisia tea (AT, *Ardisia compressa*) and mate tea (MT, *Ilex para guariensis*) extracts were tested. Cytotoxicity, TPA-induced ornithine decarboxylase (ODC) and quinone reductase (QR) activities were evaluated *in vitro* using HepG2 cells. The topoisomerase inhibitory activity was also tested, using the *Saccharomyces cerevisiae* yeast system. Results suggest that MT, AT and GT are cytotoxic to the HepG2 cells, with MT demonstrating dominant cytotoxicity. EGCG showed greater cytotoxicity than Q and GA against HepG2 cells. The greatest inhibition (82%) of TPA induced ODC activity was shown by Q, with 25  $\mu$ M (IC<sub>50</sub> = 11.90  $\mu$ M). Topoisomerase II, but not topoisomerase I, was the cellular target of MT, AT, EGCG, Q and GA, which acted mainly as true catalytic inhibitors. The cytotoxicity and the inhibition of topoisomerase II may contribute to the overall chemopreventive activity of AT and MT extracts. Ardisia and mate teas may thus share a public health potential as chemopreventive agents.

#### REFERENCES

1. Ghosh P, Besra SE, Tripathi G, Mitra S, Vedasiromoni JR, Cytotoxic and apoptogenic effect of tea root extract and two of its steroidal saponins of TS1 and TS2 on human leukemic cell lines K562 and U937 and on cell of CML and all patients, *Leuk Res*, 30(4), 2006, 459-468.
2. Hashimoto, F., Nonaka GI, Nishioka I., Tannins and related compounds. LVI. Isolation of four new acylated flavan-3-ols from oolong tea, *Chem Pharm Bull*, 35(2), 1987, 611–616.
3. Wei JX, Zuo QY, Zhu Y, Studies on the chemical constituents of seeds of *Camellia sinensis* var. assamica, *Zhongguo Zhongyao Zazhi*, 22(4), 1997, 228–230.

4. Higuchi K, Suzuki T, Ashihara H, Pipecolic acid from the developing fruits (pericarp and seeds) of *Coffea arabica* and *Camellia sinensis*. *Colloq Sci Int Café(C. R.)*, 16, 1995, 389-395.
5. Yoshida Y, Kiso M, Ngashima H, Goto T, Alterations in chemical constituents of tea shoot during its development. *Chagyo Kenkyu Hokoku*, 83, 1996, 9–16.
6. Murakami T, Nakamura J, Matsuda H, Yoshikawa M, Bioactive saponins and glycosides. XV. Saponin constituents with gastroprotective effect from the seeds of tea plant, *Camellia sinensis* L. var. *assamica* Pierre, cultivated in Sri Lanka: structures of assamsaponins A, B, C, D and E. *Chem Pharm Bull*, 47(12), 1999, 1759–1764.
7. Davis AL, Lewis JR, Cai Y, Powell C, Davis AP, Wilkins JPG, Pudney P, Clifford MN, A polyphenolic pigment from black tea. *Phytochem*, 46(8), 1997, 1397–1402.
8. Yen GC, Chen HY, Relationship between antimutagenic activity and major components of various teas. *Mutagenesis*, 11(1), 1996, 37–41.
9. Riso P, Erba D, Criscuoli F, Testolin G, Effect of green tea extract on DNA repair and oxidative damage due to H<sub>2</sub>O<sub>2</sub> in Jurkat T cells, *Nutr Res*, 22(10), 2002, 1143–1150.
10. Chaudhuri T, Das SK, Vedasiromoni JR, Ganguly DK, Photochemical investigation of the roots of *Camellia sinensis* L. (O. Kuntze). *J Indian Chem Soc*, 74(2), 1997, 166.
11. Sagesak YM, Uemura T, Watanabe N, Sakata K, Uzawa J, A new glucuronide saponin from tea leaves (*Camellia sinensis* var. *sinensis*). *Biosci Biotech Biochem*, 58(11), 1994, 2036–2040.
12. Shokrzadeh M, Ebadi AG, Mirshafiee SS, Choudhary MI, Effect of the aqueous green leaf extract of green tea on glucose level of rat, *Pakistan journal of biological sciences* , 9(14), 2006, 2708-2711
13. Gupta J, Siddique YH, Beg T, Ara G, Afzal M, Protective role of green tea extract against genotoxic damage induced by anabolic steroids in cultured human lymphocytes, *Biology and Medicine*, 1 (2), 2009, 87-99.
14. Oyejide OO, Olushola L, Hepatoprotective and antioxidant properties of extract of *Camellia sinensis* (black tea) in rats, *African Journal of Biotechnology*, 4(11), 2005, 1432-1438.
15. Raffaella Zanchi R, Canzi E, Molteni L, Scozzoli M, Effect of *Camellia sinensis* (L.) whole plant extract on piglet intestinal ecosystem, *Annals of Microbiology*, 58 (1), 2008, 147-152.
16. Chattopadhyay P, Besra SE, Gomes A, Das M, Sur P, Mitra S, Vedasiromoni JR, Anti inflammatory activity of tea (*Camellia sinensis*) root extract, *Life sci*, 74(15),2004, 1839-1849.
17. Das SA, Mukherjee M, Das D, Mitra C, Protective action of aqueous black tea (*Camellia sinensis*) extract (BTE) against ovariectomy-induced oxidative stress of mononuclear cells and its associated progression of bone loss, *Phytother Res*, 23(9), 2009, 1287-1294.
18. Marco Vinicio Ramirez-Mares, Chandra S, Mejia EG, Invitro chemopreventiveactivity of *Camellia sinensis*, *llexpara guariensis* and *Ardisia compressa*, *Mutat res*, 554, 2004, 53-65.

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