

**CAMELLIA SINENSIS: A REVIEW OF ITS BOTONY, CHEMISTRY AND  
PHARMACOLOGICAL PROPERTIES****Rashmi T., Srinivas A. S.\*, Navyashree K., Pallavi K. M. and Shivu Gowda**

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**ABSTRACT**

*Camellia sinensis*, the tea plant, has been a cornerstone of traditional medicine for centuries, with a rich history of use in preventing and treating various diseases. This comprehensive review article provides an in-depth examination of the medicinal properties of *C. sinensis*, exploring its phytochemical composition, pharmacological activities, and potential therapeutic applications. We critically evaluate the scientific evidence supporting its use in managing cancer, cardiovascular diseases, neurodegenerative disorders, infectious diseases, and metabolic disorders. The bioactive compounds responsible for its medicinal properties, including catechins, theaflavins, thearubigins, and saponins, are discussed in detail. Furthermore, we highlight the potential of *C. sinensis* in developing novel drugs and nutraceuticals, and explore its synergistic effects with other therapeutic agents. By integrating traditional knowledge with modern scientific research, this review aims to provide a thorough understanding of the medicinal properties of *C. sinensis* and its potential to improve human health, while also identifying areas for future research and development.

**KEYWORDS:** *Camelia sinesis*, Chemical constituents, Pharmacological activity.**INTRODUCTION**

*Camellia sinensis*, also known as tea, has been a staple beverage for centuries, with a rich history of cultural and medicinal significance. The tea plant is a woody perennial species, which belongs to family Theaceae.<sup>[1]</sup> The global consumption is permanently increasing due to their sensory and health properties.<sup>[2]</sup> Recent studies have further elucidated its pharmacological effects and health benefits, solidifying its position as a valuable plant in modern medicine. Since many years, a surge of research has explored antioxidant,<sup>[3]</sup> anti-inflammatory, anti-analgesic,<sup>[4]</sup> anti-cancer,<sup>[5]</sup> anti-hyperlipidemia,<sup>[6]</sup> neuroprotective<sup>[7]</sup> and Cardiovascular risk.<sup>[8]</sup> Additionally, emerging applications in functional foods and beverages, cosmetics and skincare due to its antioxidant activity, and pharmaceuticals have highlighted its versatility.<sup>[9]</sup>

The growing body of evidence supporting *Camellia sinensis*'s health benefits has sparked increased interest in its potential to prevent and manage chronic diseases, cognitive function, and anti-aging. Furthermore, emerging research has explored its antimicrobial and antiviral properties, highlighting its potential in preventing and treating infections.<sup>[10]</sup>

In addition to its well-established health benefits, *Camellia sinensis* has also been investigated for its potential in treating various diseases, including cancer, neurodegenerative disorders, and mental health conditions. Its anti-inflammatory and antioxidant properties have also been explored in the context of exercise and sports nutrition.<sup>[4][7]</sup>

Furthermore, recent studies have examined the bioavailability and pharmacokinetics of *Camellia sinensis*'s bioactive compounds, as well as its potential interactions with other nutrients and medications. The development of *Camellia sinensis* based products, such as functional foods and beverages, cosmetics, and pharmaceuticals, has also been a growing area of research.<sup>[11]</sup>

This review aims to provide a comprehensive overview of the current state of knowledge on *Camellia sinensis*, including its pharmacological effects, health benefits, and emerging applications.

**Botany and Classification**

The *Camellia sinensis*, commonly known as tea, is an evergreen shrub or small tree that is a member of the Theaceae family. Although tea originated in Southern

Asia's mainland China, it is now grown in tropical and subtropical areas all over the world.<sup>[12]</sup> When *Camellia sinensis* is grown for its leaves, it is typically trimmed to less than two meters (six feet). Its taproot is robust. With seven to eight petals, the yellow-white flowers have a diameter of 2.5 to 4 cm. The leaves are 2–5 cm broad and 4–15 cm long. It is best to gather the young, light green leaves for making tea; short white hairs are seen on the unfavorable young, light green leaves. Diverse leaf ages create diverse tea characteristics; older leaves are a darker green.<sup>[13][14]</sup> Their chemical compositions are different. Tea oil, which is slightly sweeter than green tea, can be extracted from the seeds of *Camellia sinensis*.<sup>[15]</sup>

### Distribution and Cultivation

It is believed that Tea came from China. After, it expanded to other Asian nations that are close by. It is mostly grown in Kenya, China, India, and Sri Lanka. China is the world's greatest country in terms of cultivation and output, accounting for 35% and 40% of the world's total plantation and production, respectively, with many other nations following suit. 15% of tea is consumed worldwide. Every year, about 2.5 million tons of dry tea are produced. About 25% of the over \$43 billion in yearly global sales are accounted for by tea. The Food and Agriculture Organization (FAO) projected that by 2027, the world's Tea production would amount to 3.6 million tonnes, representing a 7.5% yearly increase. Between 2015 and 2017, the output of GT is expected to increase by almost 100%, reaching 3.3 million tonnes.<sup>[16]</sup>

### Taxonomy

	Plantea
Subkingdom	Tracheobionta
Phylum	Spermatophyte
Subphylum	Angiospermae
Class	Dicotylodonae
Subclass	Dilleniidae
Order	Theales
Family	Theaceae
Genus	<i>Camellia</i>
Species	<i>Sinensis</i> <sup>[17]</sup>

### Common names

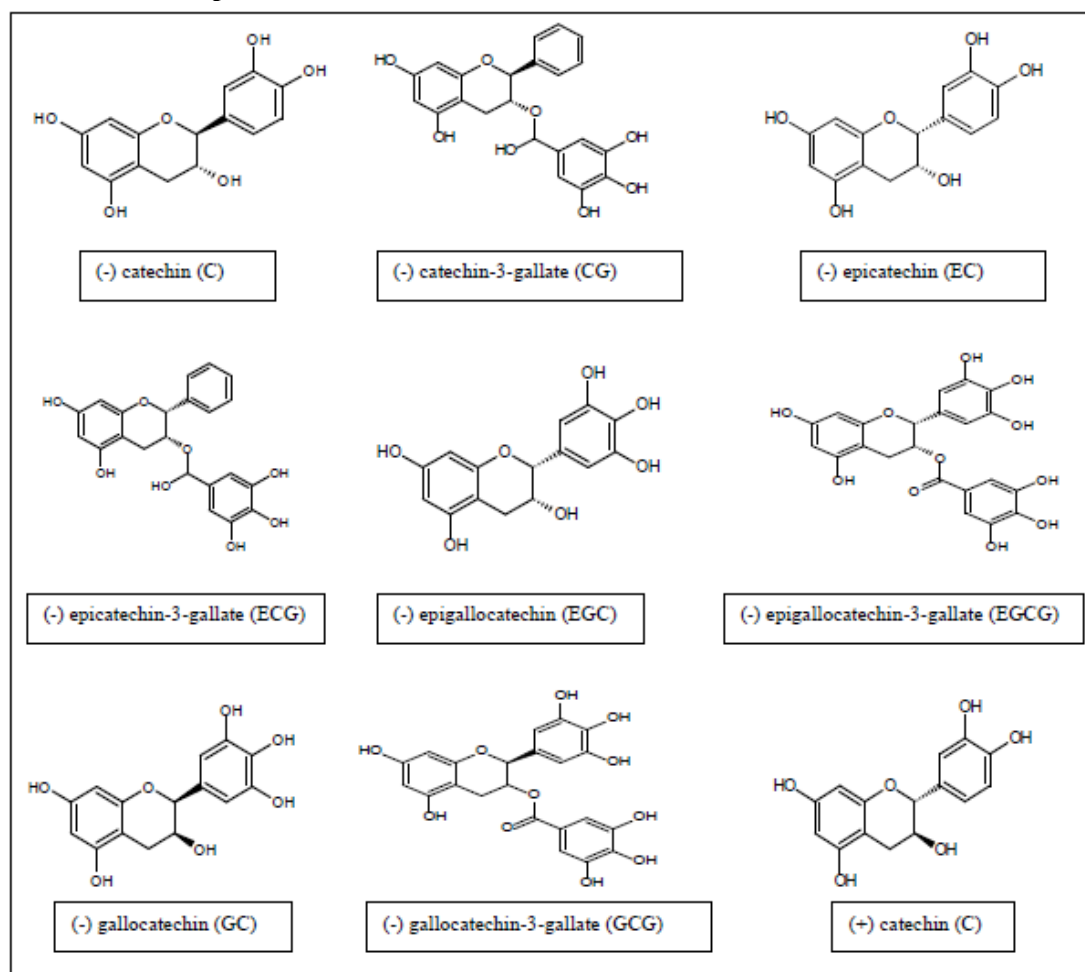
India	Chha
China	Cha
Russia	Chai
Africa	Itye
Italy	Te
England	Tea plant
United State	Tea <sup>[15]</sup>

### Phytochemical constituents

Worldwide yields the consumption of *Camellia sinensis* leaves are high. The chemical constituents of the whole plant is composed of various alkaloids, amino acids

astheanine, glutamine, glutamate, proline, and aspartic acid,<sup>[18]</sup> carbohydrates, polyphenols, compounds such as catechins (C), gallic catechin (GC), epigallocatechin (EGC), epicatechin (EC), epigallocatechingallate (EGCG), catechingallate (CG), gallic catechingallate (GCG), epicatechingallate (ECG), gallic acid(GC),<sup>[19]</sup> pigments as Galactonic acid (15%), saponins mainly include sapogenins, glycosides, and organic acids, volatiles compounds like hexanoic acid, linalool, 2-phenylethanol for their Aroma and flavor.<sup>[20]</sup> Tea leaves are a great source of caffeine. It originates from tea and tea leaf waste, or sweeping waste. Small amounts of theophylline and theobromine are also present as alkaloids. The pungent yellow oil odor that gets worse. Tea leaves also contain a combination of enzymes known as thease.<sup>[17][21]</sup>

### Structure of the some compounds in *camellia sinensis*



### Pharmacological activities

#### Anti-oxidant activity

To avert and terminate oxidative stress, antioxidants are used to scavenge free radicals. Green tea leaves are rich in phenolic antioxidants that can be used to make dietary supplements, cosmetics, and medications that have anti-oxidant properties. Potentiometric analysis was used to determine these extracts' antioxidant activity.<sup>[22]</sup>

#### Antiviral activity

Newcastle illness Virus (NDV) is a significant global illness that affects chicken farms. An *in vivo* assay is used to test *Camellia sinensis* leaves for the presence of the Newcastle disease virus (NDV). Strong antiviral activity of *Camellia sinensis* against NDV has been observed *in vivo*. When it came to alkaloids, flavonoids, phenols, tannins, saponins, cardiac glycosides, steroids, proteins, and carbohydrates, the methanol extract performed remarkably well. The remaining extracts could be able to inhibit the Newcastle disease virus (NDV).<sup>[23]</sup>

#### Antibacterial activity

The amount of Epigallocatechin-3-gallate (EGCG) found in green tea leaves is relatively high. EGCG functions well as an antimicrobial. Leaves of green tea with a high

economic worth, stability, and efficacy green tea leaves as a consistent and efficient means of testing antibiotics against *S. epidermidis*, or *Staphylococcus epidermidis*.<sup>[24]</sup>

#### Anti-inflammatory activity

Flavonoids and catechin, found in green tea, are potent antioxidants that also function as metal chelators, free radical scavengers, lipoperoxidation inhibitors, and blockers of the formation of molecules involved in inflammatory pathways.<sup>[25]</sup>

#### Antimutagenic and Anticarcinogenetic activity

Tea extracts and polyphenols, such as EGCG and ECG, have been shown to exhibit antimutagenic efficacy against a range of mutagens in microbial systems, mammalian cell systems, and *in vivo* animal studies. Tea phenols have demonstrated their anticarcinogenic properties in a variety of experimental animals, including rats and mice, transplantable tumors, carcinogen-induced tumors of the digestive tract, mammary glands, lung cancers, skin tumors, leukemia, tumor promotion, and metastasis. Because tea polyphenols have antimutagenesis and anticarcinogenesis properties, it is possible that both extracellular and intracellular mechanisms such as metabolism regulation, blocking or suppression, modification of DNA replication and repair

effects, promotion, inhibition of invasion and metastasis, and induction of novel mechanisms may be responsible for the inhibition of tumors.<sup>[26]</sup>

#### Antimicrobial activity

Tea's polyphenol fractions have been thoroughly investigated for their antimicrobial qualities, EC was significantly less active than EGCG, and *S. aureus* was more susceptible than *Escherichia coli*, which is consistent with EGCG binding to *staphylococci* significantly more. The main cause of EGCG's bactericidal effect was membrane perturbation.<sup>[27]</sup>

#### Antiaging activity

Green tea is a promising candidate for antiphotaging therapy because of its polyphenols' strong ROS scavenging action. Mice with photaging skin were reported to have improved skin when given an aqueous extract of green tea. It was discovered to have anti-aging properties by increasing the amount of collagen and elastin fibers and decreasing the production of MMP-3 enzymes that break down collagen.<sup>[28]</sup>

#### Antistress activity

An amino acid found in tea called theanine has powerful anti-stress benefits for both people and animals. The major ingredients of tea, gallate type catechins and caffeine, however, hindered theanine's effects and responsible for antistress activity.<sup>[29]</sup>

#### Antiparkinson activity

Green tea polyphenols have been shown to have a variety of pharmacological effects against Parkinson's disease (PD) by altering the expression of many genes and disrupting signaling networks. Green tea polyphenol, EGCG has been demonstrated to shield SH-SY5Y cells from the neurotoxicity caused by 6-OHDA by preventing the accumulation of ROS, reestablishing MMP, and preserving calcium homeostasis.<sup>[30]</sup>

#### Anti alzheimer activity

Epigallocatechin 3-gallate (EGCG), which helps to enhance memory impairments by preventing the formation of senile plaque in the hippocampal region of the brain. Furthermore, because of its antioxidant qualities, EGCG may shield cultured hippocampal neurons from the neurotoxicity caused by  $\beta$ -amyloid. And responsible for the Alzheimer activity.<sup>[31]</sup>

#### Cardiovascular diseases

One of the most prevalent and well researched catechins in green tea, epigallocatechin-3-gallate, is linked to a decrease in atherogenesis and the risk of cardiovascular disease (CVD) while also maintaining vascular homeostasis and endothelial function. Growing data from epidemiological suggests that green tea catechins have a significant impact on vascular function.<sup>[32]</sup>

#### Antidiabetic activity

The quantity of bioactive ingredients, including polyphenols, that tea leaves contain and which add to their health advantages for humans. Tea flavonoids contain antioxidants that help protect pancreatic cells from damage caused by free radicals. The information in tannins and alkaloids, including epigallocatechin, also helps to regulate blood sugar levels by preventing the body from absorbing glucose in the stomach.<sup>[33]</sup>

#### Anticancer activity

Polyphenol flavonoid catechins, such as (–) epicatechin, (–) epigallocatechin, and epigallocatechin-3-gallate (EGCG), are its phytochemical constituents. The main catechin, EGCG, has been shown to be quite efficient in preventing carcinogenesis. By inhibiting several molecular mechanisms such as the mitogen-activated protein kinase pathways, growth factor cell signaling, NF $\kappa$ B pathways, activation of apoptosis, and suppression of other molecular mechanisms, EGCG prevents tumorigenesis and malignancies. One of the most effective anticancer compounds, EGCG has little cytotoxicity while maintaining maximal efficiency. Not only does this validate green tea's anticancer properties, but it also offers researchers fresh insights for developing safe and effective anticancer medicines.<sup>[34]</sup>

#### Toxicity

This toxicity mechanism may be connected to the liver's oxidative stress induction. But the hazardous quantities that were found were far more than what one would typically consume in tea. whether EGCG, in response to metal ions and H<sub>2</sub>O<sub>2</sub> oxidative stress, may oxidatively damage bovine thymus DNA *in vitro*. They found that EGCG encouraged the synthesis of 8-oxide, a distinctive form of oxidative DNA damage that is closely linked to cancer and mutations. And concluded that this oxidative damage to EGCG may be taken into account as a possible risk factor for the carcinogenicity of EGCG.<sup>[35]</sup>

#### CONCLUSION

In conclusion, *Camellia sinensis* has emerged as a versatile and valuable plant with a wide range of medicinal properties, making it a promising therapeutic agent for various diseases. The overwhelming evidence from scientific studies confirms its potential in preventing and managing cancer, cardiovascular diseases, neurodegenerative disorders, infectious diseases, and metabolic disorders. The bioactive compounds present in *C. sinensis*, particularly catechins, theaflavins, and thearubigins, have been shown to possess remarkable pharmacological activities, including antioxidant, anti-inflammatory, and anti-proliferative effects. As research continues to unravel the mysteries of *C. sinensis*, it is clear that this ancient plant holds immense potential for modern medicine. Further studies are needed to fully explore its therapeutic applications, optimize its bioactive compounds, and unlock its secrets. Ultimately, *Camellia sinensis* stands as a testament to the

power of traditional knowledge and the importance of integrating nature and science to improve human health.

#### Author contribution

All Authors Contributed equally.

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