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A REVIEW ON PHYTOCHEMICAL AND PHARMACOLOGICAL ACTIVITY OF *CAMELLIA SINENSIS* (TEA LEAVE)

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ABSTRACT

A common plant with numerous beneficial applications to human health is *Camellia Sinensis*. It contains different important chemical constituents such as polyphenols 10 to 30%, caffeine, aroma chemicals, fats, vitamins, catechins, flavanols, flavanones. Caffeine is used in a wide range of pharmaceutical formulation and beverages, ayurvedic medicines. Tea leaf is used for increasing blood pressure, increasing heart rate and also stimulates CNS. The current review is effort highlight the ethnobotany, phytochemical and pharmacological reports on Camellia sinensis. Phytochemical constituents of tea leaf is carbohydrates, polyphenols, Alkaloids (caffeine, theophylline, and theobromine), protien. Nutritional compounds, Amino acid, and proteins, Volatile compounds, Flavonoids, Pigments, Enzymes, Volatile, minerals. The various solvent systems n-Hexana, petroleum ether, chloroform, ethanol, methanol, water have separated caffeine from a green tea leaf. A scrutiny the of literature revealed some notable pharmacological activities of the plant such as antiviral, antibacterial, antimutagenic, antimicrobial, hypocholesterolemic, anticoccidial, antihypertensive, antiaging, cardiovascular, anti carriers, antistress, health benefits of tea (population-based studies) and antileishmanial, anti-cariogenic, antioxidant, anti-inflammatory, anticancer activity.

KEYWORDS: Introduction of *Camellia sinensis*, ethnobotany of plant, pharmacognosy of plant, pharmacological activity of the plant.

1. INTRODUCTION

Green tea in Asian countries has been popular drink, and is consumed all over the world.[1] Three major types of tea are- oblong, green, and black. These characterized by degree of fermentation.[2] The components of green tea include 10-13% (w/w) polyphenols (2-4%w/w) caffeine, aroma chemicals, fats, vitamins, amino acid, chlorophyll, other the strain of tea tree manufacturing process employed, harvest time varies according to the ingredient of tea. Generally, A significant number of polyphenol, flavonoid, amino acids, phenolic acid, carbohydrates, caffeine, lipids and volatile compounds are found into the biomolecular composition of tea extracts. Anti-cancer, anti-diabetic, anti-mutagenic, ant-imicrobial, cardioprotective and neuroprotective antioxidants have been recorded to use tea polyphenols. There have also been studies of various health benefits from other bioactive compounds such as amino acid and caffeine.[3] Tea leaves contain 1-4% caffeine.[4] Caffeine is a white crystalline, bitter in taste and odourless powder. It is derivative of the xanthine nucleus.[5] Pharmacological properties of caffeine is CNS and metabolic stimulation. The German chemist Friedrich Ferdin and Runge first discovered caffeine ($C_8H_{10}N_4O_2$) in 1819. The word 'caffeine' is coined ‘kaffeine’. Caffeine, theophylline and theobromine are methylxanthine derivatives.[6] It is also known as 1, 3, 4 trimethyl, xanthine. It used in wide range of pharmaceutical formulation and beverages, Ayurvedic medicines.[7] The presence of a high number of alkaloids and catechins is underlined in Tea leaves. *Camellia Sinensis* a herbal plant with health benefits for humans.[8, 9]

Fig. Green Tea Plant, Tea Leaf, Flower, Seed.

Table 1: Taxonomy.

Kingdom	Plantae
Subkingdom	Tracheobionta
Phylum	Spermatophyte
Subphylum	Angiospermae
Class	Dicotyldonae
Subclass	Dilleniidae
Order	Theales
Family	Theaceae
Genus	Camellia
Species	*Camellia Sinensis*

Table 2: Common Name.

India	**Chha**
Russia	Chai
Africa	Ityl
Italy	Te
England	Tea

2. ETHNOBOTANICAL CHARACTERISTICS OF PLANT

Camellia sinensis cultivated in tropical and subtropical climates best for growth of tea plant. Altitudes from sea level 2100 meters above sea level. It grows slightly sandy soils and medium loamy soils that are well-drained. It requires moist soil and prefers pH 5 to 7. The Tea needs warm weather and shade to grow fruitfully and rainfall of about 80-100 inches a year.[10]

3. MACROSCOPICAL CHARACTERISTICS OF PLANT

Chemical name of tea leave is *Camellia sinensis* and belonging *Theaceae* family. It is a small evergreen tree or bush which reaches 1.0-1.5 meters in height, while wild-growing plants reach up to 6.0 meters.

Shrub- 1-5 M tall. Young branches of tea plant garish yellow in colour and terminal buds silvery gray.

Leave- The leaf are long 4-15 cm and broad 2-5 cm, older leaves are dark green in colour and glabrous. Young leaves are light green in colour and hairy, upper surface elliptical or lanceolate, blunt or acuminate at apex base is tapering margin shortly serrate. Petiole 4-7 mm.

Diameter- It is a 5 sepals, 6-8 petals, stamens numerous and 0.8-1.3cm, ovary globose, capsule oblate.

Fruit-Is a flattened, smooth

Seed- It is a brown in colour, and subglobose, 1-1.4cm in diameter.

Odour- It is a characteristic**.**

Taste- It is a bitter in taste.[10, 11, 12]

4. MICROSCOPICAL CHARACTERISTICS OF PLANT

Transverse section of a leaf through the midrib contains epidermis, cuticle, mesophyll, calcium oxalate crystals, sclereid cell, and trichomes, stomata. The top epidermis formed by a thick cuticle is composed of strongly wavy polygonal cells. Consists of its self stomata and hairs like structure present in both surfaces of a leaf is known as unicellular trichomes (Irregular and branched). That is lower epidermis surface larger than the upper. Two rows of palisade cells and large lignified cells are produced in the Mesophyl Zone, which emerge from one epidermis to the other at certain intervals and spread throughout the mesophyll. It contains crystals of calcium oxalate that are scattered in vascular bundle and parenchyma. In the Midrib region there is a prominent ridge both above and below and a vascular bundle consisting of xylem and phloem, with a slightly lignified band of pericyclic fibres covering the whole region. In the widest area, pericyclic fibres are up to four in width. The rest is spongy parenchyma with broken lignified sclereids.[13,14,] Powder microscopical characters-characters of powdered tea are: Trichomes (Irregular and branched), sclerenchymatous cells, petiole, midrib, stomata and Calcium oxalate crystals is present.[15]

5. PHYTOCHEMISTRY OF PLANT-

Camellia sinensis leaves are high worldwide in yield and consumption. A number of alkaloids, amino acids, carbohydrates, Polyphenols, pigments, volatils, fluoride compounds, trace minerals and unknown compounds form the chemical composition of a whole plant. Tea leaves are a rich caffeine source. It is derived from waste or sweeping waste from tea and tea leaf. Theobromine, theophylline are also found small amount. The color of the leaves is caused by gallotanic acid (15%). The aggravated smell caused by volatile yellow oil. The enzyme mixture called thease is also found in the tea leaves.

5.1 Carbohydrate: Adding sweetness in to the tea leaves, helping to drive enzyme reactions that occur during oxidation and also contributing to polyphenols in young tea leaves. Consist of monosaccharides, disaccharides, and oligosaccharides responsible for astringency a taste (includes catechins).

5.2 Polyphenol: Large group of bio compounds from plant material which includes phenolic acid (particular hydroxybenzoic acid) and flavonoids. Polyphenol is composed of many

phenolic groups. The bud and the blade have the highest polyphenol level, and the levels of caffeine and polyphenols have dropped by 2 to 3 times in each leaf.[16]

5.3 Alkaloids: caffeine, theophylline, theobromine and the glutamide derivatives is main alkaloids.[17]

5.4 Nutritional Compounds: vitamin E, C, B, fluoride and potassium is nutritional compounds.

5.5 Amino Acid and Proteins: L-theanine contained in the tea to relieve cognitive tension, used in combination with caffeine (r-aminobutyric acid), demonstrate future improvements in learning tasks. L-theanine may also provide a "mindful alertness" disorder in a tea drinker in combination with caffeine. On average, amino acid constitutes 6 per cent of the solid extract in the steep tea.[17]

5.6 Volatile Compounds: Tea leaves have a big liability for the volatile substances in a tea. Aroma and flavour, others come from the actual production process.[17]

5.7 Flavonoids: Flavonols in tea are catechin, epicatechin, epicatechin gallate, gallocatechin, epigallocatechin and epigallocatechin gallate is the main component of tea leaves. The catechins are graded according to their structure in two classes-

(a) Epistructured catechins also called as EGC, EG, EGCG, ECG.

(b) Non- epistructured catechins (GC, C, GCG, catechin gallate).

These classes of flavonoids consist of flavonols, flavones, isoflavones and anthocyanins. The most prevalent and therefore most studied are flavanols (flavan 3-ols short). Sometimes tannins are called flavanols.[18]

5.8 PIGMENT: Plant pigments give colour to the leaves and absorb photosynthesis light. In fresh leave -chlorophyll and carotenoid two main groups of plant pigments. Such pigments condense for the duration of withers and oxidation allowing dark chlorophylls to degrade and become black pigment for the duration of oxidation. Another smaller pigment present in tea that is - Orange carotene and yellow xanthophylls.

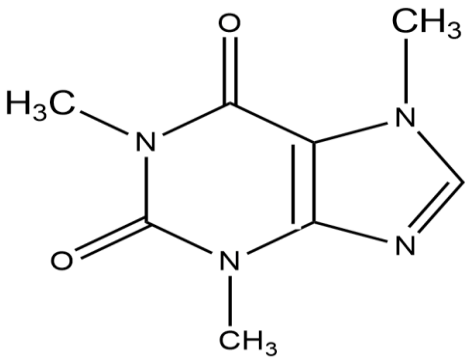
5.9 Enzymes: The most important enzymes of tea leaves are polyphenols oxidase and peroxidise. The enzyme of the browning of tea leaves is responsible, when all leaf wall is weakened and polyphenols, which are otherwise referred to as oxidation, are exposed to oxygen. The leaves can be denatured or decommissioned to induce browning by polyphenols oxidase and peroxidise.

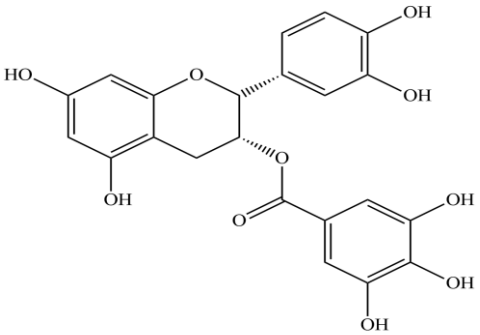
5.10 Mineral: In tea leaves, 28 mineral elements were contained. In addition, fluorine is the most studied compared with other plant, tea containing significant quantities of manganese, arsenic, nickel, selenium, iodine, aluminium, potassium. Fluorine often used in human prevention of tooth decay can cause fluorosis when eaten high levels.

5.11 Volatile: Volatile substance easily enters the through air into tea leaves, they reach olfactory system vapour. The taste and aroma of a drink are primarily caused by volatile substances and from the real development cycle. The volatile substance makes up only 0.01% weight of dry tea leaves.[16]

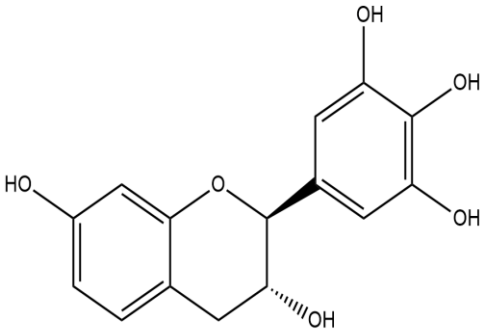
6. STRUCTURE OF THE SOME COMPOUNDS IN *CAMELLIA SINENSIS*,[16,17,18]

6.1. PHYTOCHEMISRY

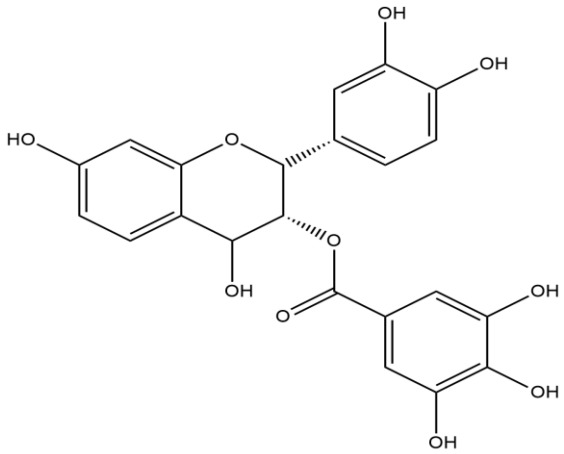




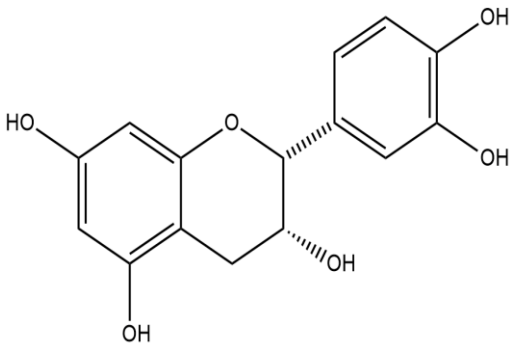
CATECHIN GALLATE (CG)



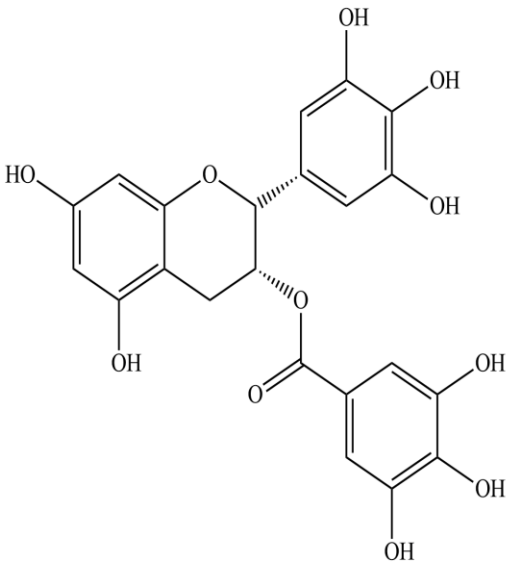
CATECHIN



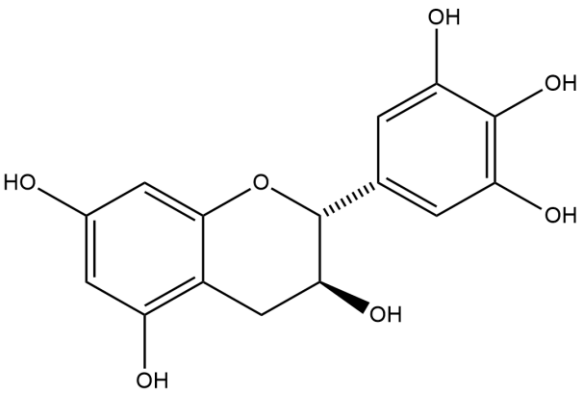
EPICATECHIN 3-GALLATE (ECG)



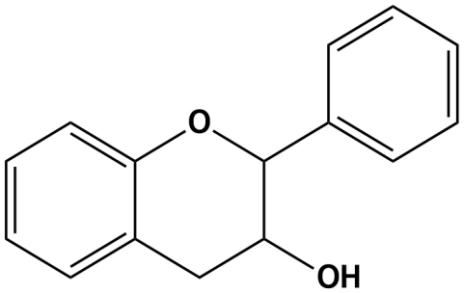
(-) EPICATECHIN



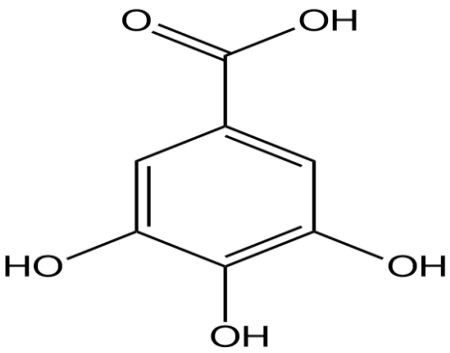
EPIGALLOCATECHIN 3-GALLATE (EGCG)



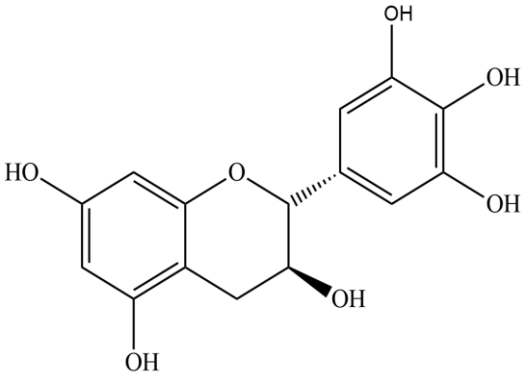
(-) EPIGALLOCATECHIN (EGC)



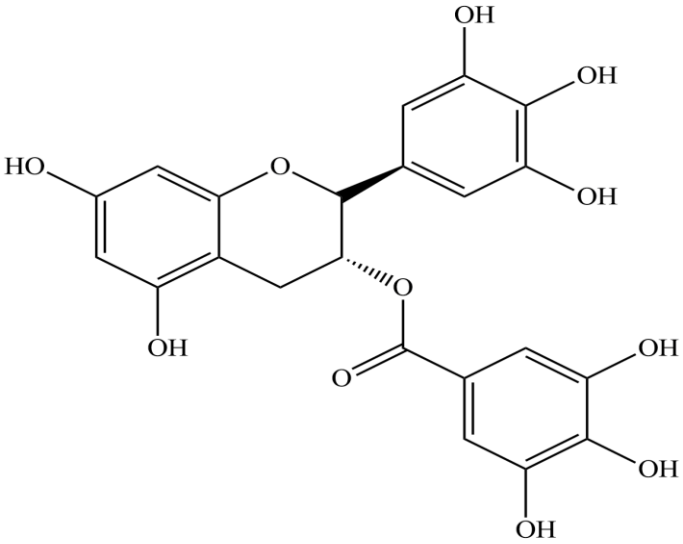
FLAVAN 3-OL



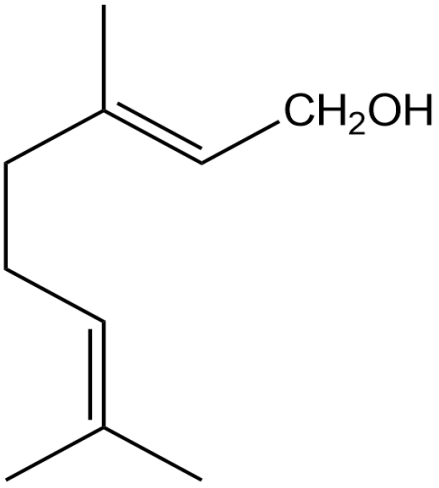
GALLIC ACID



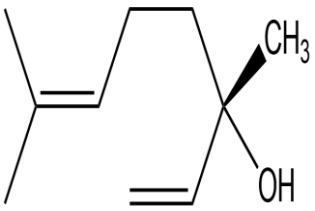
GALLO CATECHIN (GC)



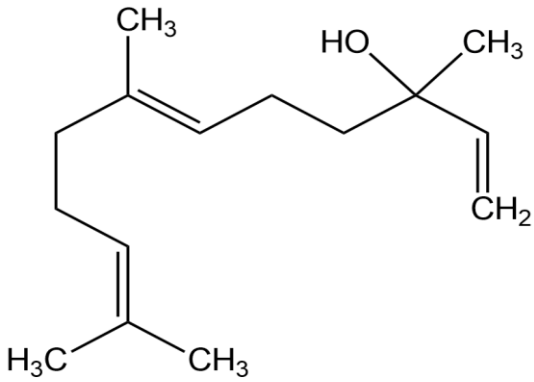
GALLOCATECHIN 3-GALLATE (GCG)



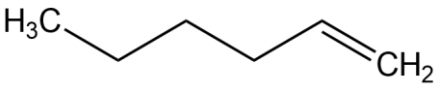
GERANIOL



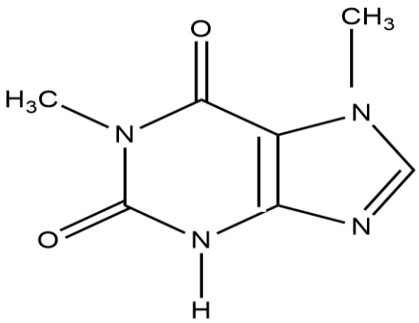
LINALOOL



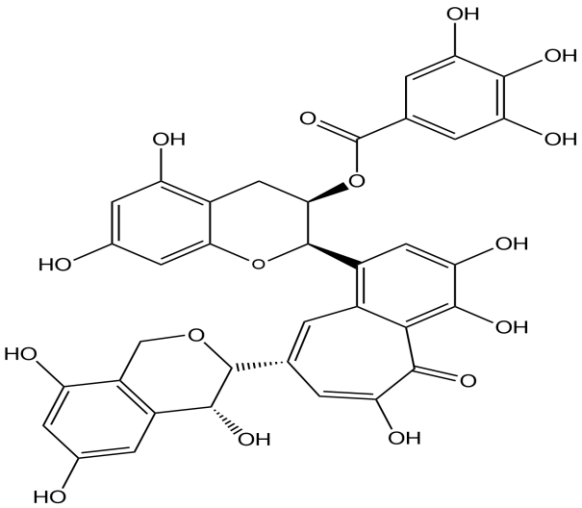
NEROLIDOL



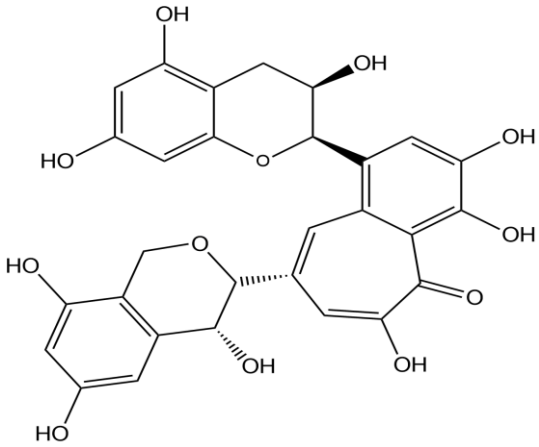
n-hexene



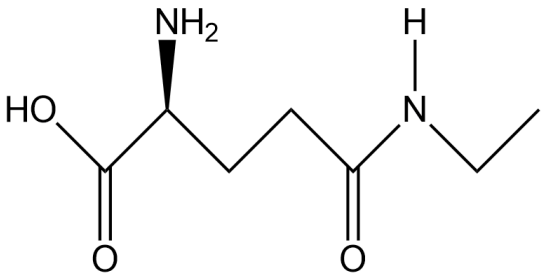
para - xanthine



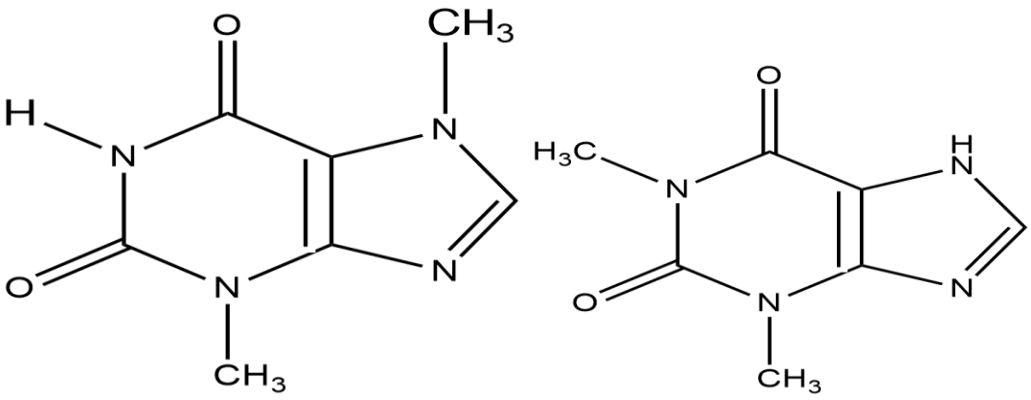
THEA FLAVIN 3-GALLATE / THEARUBIGENS



THEA FLAVIN



THEANINE



trans -2-hexene

5. TRADITIONAL USE

The whole plant of Camellia sinensis was used to treat different diseases such as migraine headaches, asthma, diabetes, low blood pressure, swelling of the liver caused by the hepatitis C virus, skin cancer, Parkinson's disease, etc. Tea is used in traditional recipes. Tea is commonly used as a flavoring in alcoholic beverage, frozen dairy treats. Seeds of the tea plant can be crushed to processed foods, soap, and cosmetics and avoid all cancers and prevent cancer cell growth without destroying healthy tissue. The tea plant can be useful as herbal medicine for rheumatoid arthritis and HIV-related immune deficiency. Blood sugar levels decrease effectively. High blood sugar levels have an effect on the vascular system and may cause atherosclerosis and retinal bleeding. Caffeine is widely accepted and used as a central nervous system stimulant, due to its cerebral vasoconstrictor effect. It is also given

along with ergotamine tartrate to potentiate the action of the latter as a specific analgesic in migraines.[10,12]

8. MEDICINAL PROPERTIES AND PHARMACOLOGY ACTIVITIES OF *Camellia sinensis* PLANT

8.1. Antiviral Activity

The antiviral activity evaluated by Mahmood M.S. *et al* (2016) Green tea's beneficial effects are primarily due to the existence of catechin-known forms of polyphenols are formed by several isomers including EGCG, EC,EGC, and catechin. EGCG's antiviral properties were shown in different levels, including direct inactivation of the virus particles, protease and adenain inhibition, and inhibition of intracellular in vitro growth, reporting green tea and its isolated catechins to cell cultures and to boiler chichens against a fowl Adenovirus type 4 by in-vitro.

8.2. Antibacterial Activity

The antibacterial action was evaluated by Patil M.P. *et al* (2016) analysis for grampositive Bacteria such as *Bacillus Aureus, Staphylococcus Aureus, Listeria Monocytogens, Staphylococcus Saprophyticus* and gramnegative such as bacteria *Proteus Vulgaris, Pseudomonas Aeruginosa, Pseudomonas Putida, and Serration Marcescens*. Both bacterium strains have been stored for 4 ° C to 3 months on tryptic soy agar plates, while stocks of 30 percent tryptic soy broth medium are stored at -80°C. Antibacterial propensity tests use the diffusion process developed by Kirby & Bauer formerly described; were used with several alterations. All dishes were incubating at 37℃ for 24hr. behind the incubation phase zone of inhibition was measured in mm.

8.3. Anticancer Activity

The anticancer activity was evaluated by Saini N. *et al* (2017) cancer is a vital threat and fearful disease which occurs due to the multiplication of irregular cells. When normal cell change into a cancer cell, it undertakes behavioural change. It is classify based on the type of cell infected from the older time, the conventional drugs & therapies similar to radiotherapy, chemotherapy, and commonly prescribed produce different side effect. A number of metabolites like flavonoids form different plant source play an important component leading to novel pharmaceutical compound anticancer drugs (anticancer agents). Flavonoids are particularly active beside cancer as they have a lot of mechanism that are organized for anticancerous activity. Flavonoids reduce the performance of certain isozymes of an enzyme-

like (CYP1A, CYP1A2, and P450) making them defensive against cancer and reduce known as anticancerous agents also.

Ung L.Q. *et al* (2019) tea polyphenols inhibit the risk of cancer including prostate, liver, lung, gastric, breast, colon and colorectal esophageal, oral activity, non-Hodgkin's lymphoma, endometrial and pancreatic cancer. Tea polyphenols have studied the invitro and in-vivo animal model experiments strongly that tea catechins have a cancer inhibitory effect against carcinogenesis at different organ sites.

8.4. Anti-inflammatory Activity

These activities were evaluated by Saini N. *et al* (2017) Flavonoids are known to act as anti-inflammatory agentsc in phytoconstituents. It operates on different routes/mechanisms, such as COX, cytokines, matrix metalloproteinases, and nuclear factor-kβ, and the compound form of flavonoids has catechol or guaiacol, such as β, with anti-inflammatory activity then shown.

8.5. Antioxidant Activity

This study aimed to examine by Soysa P.*et al* (2015) Tea includes a wide variety of activate compounds which are dependable for their human health's advantages. That the kinetics extraction of a phenolic compound, gallic acid, caffeine, catechins, the deviation of anti-oxidant activity with time after making tea brew phase. Anti-oxidant activity was measured using radical scavenging of DPPH and anti-oxidant ferric reduction assays.

Roshanak S.*et al* (2016) Total flavonoids, total phenolic content, anti-oxidant functions, vitamin C and colored features of tea are assessed. In common, exposure to air has increasing anti-oxidant activity, total flavonids, chlorophyll content, and reduced vitamin C content. The antioxidant content of fresh plant material (phenolic compound, vitamins, etc.) was high than those of dried plant materials due to drying decompression; recent study indicates that dried plant material yield higher rates of antioxidant activity than fresh plant materials, such as polyphenolic materials and antioxidants. The maximum phenolic total content (TPC) was obtained at 60°C.

Patil M. P.*et al* (2016) 2-2diphenyl 1-1picrylhydrazyl free radical scavenging assay (FRS), reduced power and total anti-oxidant assay has been performed with ant-ioxidant activity,

by using following formula is the has been inhibition of free radical scavenging activity was calculated:

$$\%\ Inhibition = \frac{(Control\ Absorbance - Test\ Absorbance)}{Control\ Absorbance} \times 100$$

The extract of methanol exhibits potent anti-oxidant activity and all bacteria were vulnerable extract of the methanol.

8.6. Antimutagenic Activity

The antimutagenic activity was evaluated by Ung L.Q.*et al* (2019) the antimutagenic activity often polyphenols was studied through mammalian and microbial in-vitro & in-vivo models which were reported.

In some animal model studies, oral administration of green tea and black tea can decrease the tumor-initiating power of the effective mutagen and the amount of chromosome damage (micronuclei) in the peripheral blood of mice administered with benzopyrene and no similar protective result of tea against the chromosome destructive action of γ-rays.

8.7. Antimicrobial Activity

The antimicrobial activity was evaluated by Nonthakaew A.*et al* (2015) tea is a major source of caffeine. It is harmless for the user and useful as an anti-microbial substance in food, eating a lot of caffeine (> 400 mg per day) to affect your body, and the end result has specified amount of caffeine used in different food products. The concentration of caffeine inhibiting mould growth was found to be 62.5 to > 2000 μ g / ml.

8.8. Hypocholestrolemic Activity

The hypocholesterolemic effect was studied by Ahmad M. *et al* (2014) tea and catechins lead to decreasing human body fat. Anti-atherosclerotic effects of catechins include also been report. It is found that catechins decreased plasm total cholesterol, level and lesser the atherogenic index HDL cholesterol indicat that they exert a hypo-cholesterolemic outcome in cholesterol fed rats.

Catechins have been shown to prevent vascular smooth muscle cell incursion by inhibit magnetotelluris(MT), (MMP) matrix metallo-peptidase activity, and (metalloproteinase-2) MMP-2 expression. Tea may relate to its protective effects on atherosclerosis by preventing infiltration and matrix deprivation.

8.9. Antiaging Activity

Mahmood T. *et al* (2010) Free radical aging theory suggests that oxidative pressure and improved free generation of radicals lead to functional decline and degeneration. Parkinson's disease, cardiovascular disorders and diabetes are all caused by changes in the balance between oxidants and antioxidants.

Green tea maintains the serum lipids and proteins free from oxidative damage, which is strengthened by aging. Green tea also lowers a marker level in the liver-kidney for oxidative DNA damage, 8-oxo deoxyguanosine, and cerebrum. Thus, green tea polyphones are useful against the harm caused by ageing progression.

8.10. Health Benefits of Tea (Population Based Studies)

Zhna L. *et al* (2019) the numerous activities documented the health benefits of tea extract and tea infusion, and several studies are focused on cell bioassay or cell-based models.

The present research, toxicity of tea polyphenol during in-vitro processing, all the health benefits of tea were investigated from the animal experimental models or human interaction studies. Tea polyphenols provide many health benefits and shown beneficial effects.

8.11. Antistress Activity

Unno K. *et al* (2017) L- Theanine, an amino acid in tea, showed antistress activity on animals and humans but the effect of L-theanine was blocked by catechins and caffeine, gallate, which are the major compounds of tea, looked at the antistress activity of tea with caffeine, low down, a human.

8.12. Anti-Cariogenic Action of Tea

Miller *et al* (2001) the various components have been shown to interfere specifically with each of the processes described above. In addition to this potentially anti-cariogenic effect, there is also direct bacterial outcome *Streptococcus mutans and S. sobrius*. Prevent of bacterial observance to teeth inhibition of glucosyl transferease.

9. RESULT AND DISCUSSION

This study indicates the potential use of tea leaves. It is herbal plant having multiple useful for health applications in humans. *Camellia sinensis* can treat different numerous human diseases. It contains the different chemical constituents which exerted many pharmacological effects. This work is based on tea chemical constituents and describes the effect of the

chemical constituent on the human body And multiple pharmacology activities has shown. Caffeine is one of the most abundant naturally occurring alkaloid found in tea. It has a basic purine ring and can be used as a CNS stimulant and some headache and migraine medications. In this study, main importance was given on the phytochemical constituents of tea leaf and collection of tea leaf in Assam. Green tea supplies a dietary source of biochemically active compounds that are demonstrated to be effective in preventing a range of human and animal viral diseases.

10. ACKNOWLEGEMENT

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