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Review Article

**MAGICAL ACTIVITIES AND MIRACULOUS EFFECTS OF
GREEN TEA - A REVIEW**Remya S B*¹, Subash Chandran M.P¹, Prasobh G.R¹, Arun T.S¹, Aparna.P¹, Sonia Ninan¹¹Department of Pharmaceutics, SreeKrishna College of Pharmacy and Research Centre,
Parassala, Thiruvananthapuram, Kerala, India. 695502**Article Received:** April 2019**Accepted:** May 2019**Published:** June 2019**Abstract:**

Purest and most unadulterated form of green tea has always influenced human health. Scientific evidences throughout the world are making people aware of health benefits associated with this herbal drink. Though green tea is not officially recognized as a medical agent, it is one of the most researched plant-based remedies whose possible benefits include promotion of cardio-vascular health, cancer prevention, skin protection, and antioxidant activity, to fight high cholesterol levels, infection, impaired immune function, diarrhoea, fatigue and many more. Laboratory findings have revealed that notable health benefit of green tea is its powerful antioxidants potential which at the molecular level, helps prevent cellular damage from certain oxidation reactions in the body. From ancient times tea is drunk worldwide as a beverage in the form of a decoction. It was used to detoxify the body. One of them is its antimicrobial property in curing various infections. Considering this, the present review has been focused on the antimicrobial aspect of green tea. This includes the history of green tea, its pharmacognostical study, chemical constituents, role and mechanism of its main chemical constituent catechin in curing antimicrobial infections and other ailments. Scope of green tea for further research and in designing and formulating drugs of it has been pondered over tea is now finding its way into topical preparations like patches. The uses of green tea are clinically proved. The antioxidant properties of green are responsible to improvement in cardiac health, atherosclerosis and it has powerful effects on the body. Catechins may reduce cholesterol levels in blood and also improve brain function.

Key words: *Magical herb, green tea, catechins, anti oxidants.***Corresponding author:****REMYA S B,**Associate Professor, SreeKrishna college of Pharmacy and Research Centre,
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INTRODUCTION:

According to Chinese legend, the history of tea began in 2737 B.C.E. when the Emperor Shen Nong, a skilled ruler and scientist, accidentally discovered tea. While boiling water in the garden, a leaf from an overhanging wild tea tree drifted into his pot. Indian history attributes the discovery of tea to Prince Bodhi-Dharma, an Indian saint who founded the Zen school of Buddhism. Whereas, some cite the Sanjeevani tea plant first recorded reference of tea use in India. Commercial production of tea in India did not begin until the arrival of the British East India Company, at which point large tracts of land were converted for mass tea production. India is one of the largest producers of tea in the world, second only to China. Commercial tea plantations were first established under the British Rule when a native variety of *Camellia sinensis* plant was discovered by Scottish traveler Robert Bruce in 1823 in the Northeastern region of India or the present state of Assam.

Tea derived from leaves of the plant *Camellia sinensis*. It can be categorized into three main types depending on the level of oxidation: green (unfermented), oolong

(partially fermented) and black (fermented) tea. It is a refreshing and aromatic drink made from steeping the leaves of *Camellia sinensis* in hot water. Tea is the second most consumed beverage in the world after water. More than 75% of all tea produced in this world is black tea, 20% is green and the rest is accounted for by oolongs, whites, and yellow tea. The synonym of the green tea plant is *Camellia thea*. The biological source of the plant is that it contains the prepared leaves and leaf buds of *Camellia sinensis* or *Thea sinensis* (Linne) O. Kuntze, belonging to family Theaceae.

Tea is manufactured in four basic forms, green, white, oolong and black tea, all of which come from the leaves of *Camellia sinensis* plant. White tea is the least processed type of tea and has the highest catechin content. It is made of young tea leaves or buds steamed immediately after harvesting to inactivate polyphenols oxidase, the enzyme that destroys catechins. White tea is richer in catechins than green tea. About three billion kg of tea is produced and consumed every year. Green tea is mainly consumed in Japan, China and India.



Figure I. Pictorial image of green leaves.

Of the tea produced worldwide 78% is black tea which usually consumed in western countries, 20% green tea, normally consumed in Asian countries, and 2% is Oolong tea which is produced by partial fermentation in Southern China. The first documented report on antibacterial action of tea was made in 1906, when Mc Naught, a British Army surgeon, showed that tea killed the causal organisms

of typhoid fever (*Salmonella typhi*) and brucellosis (*Brucella melitensis*). Green tea not only captures the taste, aroma and colour of spring, but delivers its qualities along with the highest concentration of beneficial phytonutrients and the least caffeine of all the teas[1]. Its secret lies with its rich source of catechins (polyphenols) which possess powerful antioxidant properties.



Figure II. Pictorial image of green leaves stalk

The catechins have been found to possess antibacterial and antiviral as well as Anticarcinogenic and antimutagenic properties. Over the last years, numerous epidemiological and clinical studies have revealed several physiological responses to green tea which may be relevant to the promotion of health and the prevention or treatment of some chronic diseases. However, the results from epidemiological and clinical studies of the relationship between green tea consumption and human health are mixed. For example, conflicting results between human studies may arise in part, from ignoring socioeconomic and lifestyle factors as well as by inadequate methodology to define tea preparation and intake.

Macroscopic characters of green tea:

It is a small evergreen shrub when cultivated reaches to the height of 1.0-1.5 meters, while wild growing plants reach up to 6.0 meters. Plant is much branched and bears grey bark. The colours of the leaves are dark green, lanceolate or elliptical, blunt at apex, base is tapering and margin is shortly serrate[2]. Young leaves are hairy while matured leaves are glabrous. Flowers are solitary or in groups of 2 or 3 in the leaf axils, and drooping. The odour of the leaves is characteristics and aromatic and the taste is slightly bitter. The Cultivation and Collection of green tea is not a very tedious process but requires skilled labour and proper conditions for its optimum growth [3].



Figure III. Pictorial image of green leaf powder.

Conditions of growth:

Tea bush is a tropical and sub-tropical plant and thrives well in hot and humid climate. The ideal temperature for its growth is 20-30°C and temperatures above 35°C and below 10°C are harmful for the bush. It requires 150-300cm annual rainfall which should be well distributed throughout the year. While prolonged dry spell is harmful for tea, high humidity, heavy dew and morning fog favour rapid development of young leaves[4]. The virgin forest soils rich in humus and iron content are considered to be the best soils for green tea plantations. Relatively large proportion of phosphorus and potash in the soil gives special flavour to tea as is the case in Darjeeling Tea.

Cultivation methods:

Tea gardens are set up on the cleared hill slopes where shade trees are planted in advance. Seeds are sown in the germination beds and the saplings transplanted to the garden. The garden is regularly hoed and weeded so that tea bush grows without any hindrance. Use of manures and fertilizers is a common practice in the gardens. Oil cakes and green manures are widely used. Pruning of the plant is an essential part of tea cultivation. It helps in maintaining the proper shape of tea bush to a height of about one metre with about the same diameter[5].

Preparation of green tea:

Green tea is prepared by exposing the freshly collected leaves to the air until most of the moisture is removed. Then they are roasted and stirred continuously until leaves become moist and flaccid. Then they are passed to rolling table and rolled into balls and subjected to a pressure which removes the moisture. Then the leaves are shaken out on the copper pans and roasted again till the leaves assume dull green colour. Then the leaves are winnowed, screened and graded into various varieties.

Chemical constituents of green tea:

The chemical composition of green tea may vary with climate, season, horticultural practices, and age of the leaf. The active constituents in green tea are powerful antioxidants called Polyphenols. Tea contains nearly 4000 bioactive compounds of which one third is contributed by Polyphenols. Among the Polyphenols in tea, is a family of compounds called the flavanoids[6]. Flavanoids (and their fraction, catechins) are the basic phenolic compounds in green tea responsible for antioxidant activities such as neutralization of free radicals that are formed in the process of metabolism. These flavanoids contains a substance called catechins. Major catechins

present in green tea are epicatechin (EC), epigallocatechin gallate (EGCG), epigallocatechins (EGC) and epicatechin gallate (ECG)[7].

The relative catechins content of green tea depends on how the leaves are processed before drying. A certain grade of fermentation and heating of tea leaves during the manufacturing process can result in polymerization of monopolyphenolic compounds such as the catechins, leading to conformational changes and thus modifying its properties. Other factors influencing catechin content are the geographical location and growing conditions (soil, climate, agricultural practices, and fertilizers), the type of green tea (e.g., blended, decaffeinated,) and the preparation of the infusion (e.g., amount of the product used, brew time, temperature. Green tea is said to contain over four times the concentration of antioxidant catechins than black tea, about 70 mg catechins per 100 ml compared to 15 mg per 100 ml of black tea.

Antioxidant activity of ECG is about 25-100 times more potent than vitamin C and E and is the single most studied catechins in relation to health contributing potential. The mode of action of Epigallocatechin gallate (EGCG) is supposed to be a consequence of its non-specific ability to denature protein. Epigallocatechin (EGC) has a poor level of direct activity and cause severe disruption in the process of cell division in Methicillin resistant *Staphylococcus aureus*, MRSA. Epicatechin (EC) may improve blood flow and has potential for cardiac health. Epigallocatechin (EGC), one of green tea polyphenols, has been shown to inhibit growth of cancer cells. However its mechanism of action is poorly known. EGC strongly inhibit the growth of breast cancer cell lines (MCF-7 and MDA-MB-231) but not that of normal breast epithelial cells. In humans, ECG has been found to be more highly methylated than EGC and EGCG, and EGCG has been found to be less conjugated than EGC and EC.

Green tea extracts, containing polyphenols have biological activities including modulation of key signal transduction pathways; however, the possible significance of these activities in inhibition of carcinogenesis in vivo depends on the bioavailability of polyphenols[8,9]. The yellow color in green tea infusion is mainly determined by the water soluble flavonols (1.3 to 1.5% of the tea leaves dry weight), which include kaempferol, quercetin, isoquercetin, myricetin, myricitrin, rutin, kaempferitrin, etc and flavones (0.02% of the tea leaves in dry weight) which include apigenin,

isovitexin, vitexin, saponarin, vicenin-2, etc as well as their glycosides; besides the water soluble anthocyanins.

Other polyphenols present in green tea are flavanols and their glycosides, as chlorogenic acid, coumarylquinic acid. Amino acid degradation is involved in the biogenesis of the tea aroma. Chlorophyll, carotenoids, lipids and volatile compounds are not major constituents in a tea brew but they also play an important role in the development of the aroma. Green tea also contains carbohydrates, vitamins E, K, A, low levels of B vitamins and vitamin C. Metal analysis of Green tea reveals that it is rich source of mineral elements which are essential for health like zinc, manganese, iron, magnesium, silver, copper, titanium, aluminium, bromium[10], sodium, potassium as well as nickel, chromium and phosphorus 22-25, 27. These metal ions promote the antioxidant property of green tea. The concentration of non-toxic metals like Ag, Na, Cr in Green Tea lies within the acceptable daily intake. Among these Ag in tea samples is relatively higher than other heavy metals[11].

Antimicrobial activity mechanism of green tea:

A number of epidemiological surveys have indicated that green tea consumption is linked to lower incidences of various pathological conditions, including cardiovascular disease, strokes, obesity and cancer. Recent clinical studies have revealed physiological responses to tea extracts that may be relevant to the promotion of health, as well as the prevention or treatment of these chronic diseases; furthermore, inconsistencies between some studies should be soon be resolved by improved approaches to their evaluation. These effects have been attributed, in part, to the antimicrobial, antioxidative and free radical scavenging activities of the polyphenolic components. Evidence has recently emerged, however, to suggest that these molecules have the capacity to modulate the physical structure of cell membranes. A number of membrane-dependent cellular processes, such as cell signaling and the cell cycle, arachidonic acid metabolism and cell proliferation, and apoptosis and mitochondrial functionality may be influenced by the interaction of catechins with the cellular phospholipid liposome membrane with PC. EGCg, but not EC, caused strong aggregation and NPN-fluorescence quenching of PC-liposomes and these actions were markedly lowered in the presence of negatively charged lipids. These results show that bactericidal catechins primarily act on and damage bacterial membranes. The observation that Gram-negative bacteria are more resistant to

bactericidal catechins than Gram-positive bacteria can be explained to some extent by the presence of negatively charged lipopolysaccharide. Other therapeutic effects of green tea other than exhibiting antimicrobial properties green tea is known to possess anti-inflammatory, anti-bacterial, anti-fungal and anti-oxidative property[12].

Properties of green tea [13,14,15]

Antioxidant properties:

Green tea and its supplements generally contain higher amounts of disease fighting anti-oxidants called polyphenols. Strong antioxidant potentials of tea flavonoids in suppressing the production of excess free radicals. Major catechins present in green tea i.e. epicatechin (EC), epigallocatechin gallate (EGCG), epigallocatechins (EGC) and epicatechin gallate (ECG) have strong antioxidant potentials. The higher antioxidant activity of green tea makes it more beneficial in protecting the body from oxidative damage due to free radicals. It is appeared that these antioxidants slow or halt the initiation of cancer, heart disease, suppresses immune function and accelerated aging. EGCG is the most potent one and has also been found to outperform vitamin C and β carotene 10 times in scavenging the allyl peroxy radical. However, at the same time evidences in a study suggests a reverse correlation between the amount of phenolic compound in green tea and its antioxidant potentials i.e., the quantity of these phenolic compounds is not always correlated with its quality.

Nano particles:

Nanotechnology has emerged as a promising technology that has been advocated for the delivery of antimicrobial phenolic compound extracts. Green silver nano particles have been synthesized using various natural products like green tea *Camellia sinensis* which is non polluted, environmentally acceptable, and safer for human health. Phenolic compounds can be used as natural and safer alternatives to chemical disinfectants in food systems and delivery of antimicrobial agents using nano particles to better control pathogens for commercial food safety applications.

Effectiveness in skin damages:

Green tea is effective in the area of skin care, particularly in alleviating the symptoms of acne and eczema. When used in a combination with sunscreen, green tea enhances sun protection. Due to the presence of antioxidants, green tea is also effective in slowing down the process of aging. Green tea extract has proved to be effective for the treatment

of patients who have suffered from skin damage following radiotherapy for cancer. Green tea acts at the cellular level and reduces inflammation by inhibiting the inflammatory pathways. In the same study it was revealed that tea extracts reduce the duration of radiation induced skin damage by up to 10 days in patients who received radiation treatment. There is preliminary evidence that green tea may inhibit matrix metalloproteinase (MMP), the enzymes whose excessive activity contributes to age-related degradation of the skin matrix. Green tea has been found to reduce the release of pro-inflammatory cytokines such as IL-1 β , IL-6, IL-8, TNF- α and prostaglandin E-2 (PGE-2) in human white blood cells in culture. Ref The in vitro and in vivo animal and human studies have suggested that GTP are photo protective in nature, and can be used as pharmacological agents for the prevention of solar UVB light-induced skin disorders including photo aging, melanoma and non-melanoma skin cancer .

Oral health:

Among oral diseases like dental caries, periodontal disease, and tooth loss dental caries is a multifactorial infectious disease in which nutrition, microbiological infection, and host response play important roles. Streptococcus mutans is mainly responsible for causing dental caries. Green tea has proved to have anti- Streptococcus mutans activity. It has been found that routine intake of green tea may also help in fighting against these oral diseases. It promotes healthy teeth and gums. The fluoride content may have a beneficial impact on caries and may carry out a wide range of biological activities including prevention of tooth loss and oral cancer . This trace fluoride mineral reacts with the enamel of the tooth and makes it 50-70% less susceptible to decay or gum damage and helps get beautiful white teeth . A recent study suggests that there is an explicit association between the consumption of green tea and oral health. It is also evident that green tea products have been used for preventing and treating several oral and periodontal diseases. Its frequent consumption greatly reduces bad breath (halitosis). Knowing the role of periodontopathic bacteria in producing volatile sulfur compounds, antimicrobial polyphenols in green tea can improve bad breath by suppressing these bacteria . In consequence, green tea has been considered as functional food for oral health and is widely used in toothpaste formulation. Greater the concentration of catechins better the health benefits. So the consumption of green tea in comparison to other beverages may be widely recommended.

Helps combat obesity:

Green tea has recently become the latest weapon in fighting over weight conditions. It appears to fight obesity by increasing the rate of calories burning, reducing body fat levels and preventing excess weight gain. The consumption of green tea extract is associated with a statistically significant reduction in total and Low Density Lipoprotein cholesterol levels . Green tea catechins enhance exercise induced abdominal fat loss in overweight and obese adults. Green tea catechins and epigallocatechin gallate (EGCG) have been shown to reduce adipocytes differentiation and proliferation, lipogenesis i.e., birth of new fat cells; fat mass, body weight, fat oxidation, plasma levels of triglyceride, free fatty acids, cholesterol, glucose, insulin and leptin and increased beta – oxidation and thermogenesis . It has also been studied that green tea sends glucose to muscle, where it is used for energy rather than to fat tissue, where it is stored .

Good vision:

Green tea “catechins” are among a number of antioxidants such as vitamin C, vitamin E, lutein, and zeaxanthin thought capable of protecting the eye . A study conducted at Chosun University College of Medicine in Korea discovered that the green tea antioxidant EGCG can protect human retina against UV damage. They concluded that the administration of EGCG increased the cell count and the cell activity after UV irradiation in cultured human retinal pigment epithelial cells. This suggests that EGCG provided protection against UV damage in cultured human retinal pigmented epithelial cells. In an animal trial it was found that green tea may protect against the formation of cataracts . The results suggest that green tea possesses significant anticataract potential and acts primarily by preserving the antioxidant defence system. Green tea may protect against age related macular degeneration and glaucoma . The cell culture study investigated whether green tea antioxidant EGCG could reduce free radical damage and therefore alleviate degeneration of the retina as occurs in age-related macular degeneration (AMD) and glaucoma. These findings in animal could be taken as a positive consideration for human trials and thus can enjoy this drink with an advantage.

Prevents hair loss:

So far, the benefit of green tea is known only to the body. But, green tea polyphenols are only recently understood as positive factors in hair growth and follicle health . They possess some of the mechanisms of action as including inhibition of apoptosis (programmed cell death), radioprotection

of follicle cells, profound antioxidant activity, and potential follicular inhibition of TGF-beta. Green tea is an herbal dihydrotestosterone reliable contrarian. A high intake of green tea correlates to higher levels of sex hormone-binding protein globulin (SBGH) which carries hormones like testosterone around the body in a bound, unusable form so that tissues cannot use it directly. Testosterone is usually carried around the body by this binding protein, therefore, reducing levels of free testosterone, so that it cannot be converted to dihydrotestosterone (DHT) in the hair follicle, which is thought to shorten the hair cycle and cause hair loss in men. Green tea is thought to affect the 5 α -reductase type I enzyme, which converts testosterone to DHT. Although these findings are at preliminary stage these studies suggest that further analysis in this regards can prove to promising in future.

Sore throat:

Green tea is a natural, anti-microbial, and harmless substance that can reduce the prevalence of sore throat. Drinking green tea prevents getting sore throats and colds since it helps fight the bacteria harboring in the throat and various researches have been carried out that explore the effect of green tea gargling on sore throat caused by intubation in patients after CABG surgery. The results showed that green tea gargling was effective against sore throat 12 and 24 hours after removal of endotracheal tubes.

Stomach and intestinal infections:

Helicobacter pylori is one of the most common chronic bacterial infections in man. Following the discovery of the linkage between gastric adenocarcinoma and H. pylori infection, antibiotic therapy became an important tool in Helicobacter eradication. Various chemical components of green tea have been suggested to have anti-H. Pylori effects in vitro, in vivo correlation is sparse. Interestingly, the combination of the main component of green tea (catechins) and sucralfate has a bactericidal effect on H. pylori infection in Mongolian gerbils and green tea catechins may inhibit the H. pylori urease. Several researches show that green tea extract play a vital role in curing various skin infections caused by microbes which might be fungal or bacterial infections namely Acne vulgaris, pimples and other breakouts in skin. It has been found that it can help to repair the damage from the sun, prevent premature aging and enhances skin tone too. It's the combination of its antioxidant and antimicrobial properties that make it an attractive ingredient helpful for skin rejuvenation.

Diabetes:

Various studies have shown the beneficial effects of green tea, not only on cardiovascular diseases but also on obesity and type 2 diabetes itself. According to a comprehensive review, green tea consumption is associated with decreased fasting glucose levels and A1C levels, as well as reduced fasting insulin levels, which are a measurement of diabetes health. [In a retrospective cohort study performed in Japan, a 33% risk reduction of developing type 2 diabetes was found in subjects consuming six or more cups of green tea daily compared to those consuming less than 1 cup per week]. However, a limited number of clinical trials using green tea, green tea extracts (GTEs), or its main ingredient catechin have shown disappointing results in controlling hyperglycemia in type 2 diabetic patients or protecting the condition in healthy subjects.

Obesity:

Evidences from epidemiological studies suggest the possibility of green tea being a novel strategy for treatment or prevention of obesity and diabetes. It has been shown that green tea helps to reduce obesity when consumed on daily basis. Anti-obesity effect of green tea has been associated with its content of caffeine and catechins particularly (-)-epigallocatechin-3-gallate (EGCG). Many human epidemiological studies, demonstrated beneficial effects of green tea or green tea catechins rich in EGCG in overweight management. The consumption of green tea or its catechins helps in significant reduction of body mass index (BMI), body weight and body fat by increasing postprandial thermo genesis and fat oxidation and thus also reducing cholesterol.

Urinary infections:

Escherichia coli are the most common cause of urinary tract infections. The development of antibiotic resistance in E. coli is an important problem. Finding alternative antimicrobial agents from plant extracts has received growing interest. Camellia sinensis is a safe, nontoxic, cheap beverage that has been reported to have antimicrobial effects against various pathogenic bacteria including E. coli. Polyphenolic components of green tea have antibacterial activity. Catechins also have synergistic effect with antibiotics such as chloramphenicol, amoxicillin, sulfamethoxazole, azithromycin, levofloxacin, gentamycin, methicillin, and, especially ciprofloxacin. Various data on In vivo studies have shown considerable importance on antibacterial effects of green tea and evaluating the efficacy of its catechins in the treatment of urinary tract infection.

Glaucoma:

Catechins in green tea may also help protect against glaucoma and other eye diseases. In an USA based study, 14 scientists analysed eye tissue from rats that drank green tea and found that eye tissues such as the lens and retina had in fact absorbed green tea catechins which had improved their eyesight by 20%.

Arthritis:

Green tea is rich in polyphenols which seems to have anti inflammatory property in animal test. One laboratory experiment suggested that it has positive effect on collagen-induced arthritis in mice. Another extra benefit was that the total IgG and type 2 collagen specific IgG levels were found lower the serum and arthritic joints of the mice treated with polyphenols.

Hypertension:

Some of the latest research confirms that regular intake of green tea prevents high blood pressure. The systematic review, published in the British journal of nutrition in October concluded that long-term tea intake significantly improved blood pressure. As reported in Time magazine preventing alzheimer's disease and enhancing function of brain researchers have also discovered that green tea has the potential to enhance the function of brain, and prevent age-associated brain degeneration. Specifically, EGCG appears to decrease the production of the protein beta-amyloid, which can over-accumulate in your brain, resulting in nerve damage and memory loss over time—a condition related to Alzheimer's disease. In a study, published in 2005, researchers injected pure EGCG into mice genetically programmed to develop Alzheimer's; the results showed a decrease of as much as 54 percent in the plaque associated with Alzheimer's [16].

Cancer:

Green Tea Polyphenols (GTP), particularly EGCG or EGCg (epigallocatechin gallate) not only inhibit an enzyme required for cancer cell growth, but also kills cancer cells with no ill effect on healthy cells. A team of scientists at Purdue University determined: "In the presence of EGCg, the cancer cells literally failed to grow or enlarge after division then presumably because they did not reach the minimum size needed to divide they underwent programmed cell death, or apoptosis." Although not all studies gave positive result about green tea inhibiting or preventing growth of cancer cells[17].

Antibacterial activity:

Leaves extracts of green tea indicates the presence of potent antibacterial activity. The green tea

polyphenols have been found to be inhibitory against *Escherichia coli*, *Enterococcus faecalis*, *Salmonella typhi*, *Staphylococcus aureus* and *Pseudomonas sp.* In a similar study, antibacterial activity of the water and ethanolic extracts of green tea was found against *Streptococcus mutans* and *Lactobacillus acidophilus*. Polyphenols in green tea preferentially suppress the growth of pathogenic bacteria in the gut, but not the growth of friendly bacteria. Fairly high concentration of catechins does not harm bifidobacteria, bacillus (Probiotics), good bacteria which is necessary for the functioning of the intestinal tract. Green tea polyphenols are likely to benefit the host by inhibiting pathogens growth and regulating commensal bacteria including probiotics and therefore be considered as prebiotic. The inclusion of green tea showed positive effects on the increase of lactic acid bacteria and aerobic bacteria counts in ruminants. Acidic, basic and neutral methanol extract fraction of *Camellia japonica* inhibited the growth of food borne pathogens in microbiological media and food. Green tea is also known to inhibit the reproduction and growth of medically important bacteria, like *Salmonella*, *Clostridium* and *Bacillus*. Inhibitory effect of green tea catechins on *Helicobacter pylori* infection has been reported [18]. Recently antifungal activity of green tea catechins against *Candida albicans* and *Aspergillus fumigatus* has been explored. These findings suggest that regular consumption of green tea can help us to combat with frequent bacterial infections.

Effective in renal failures:

The renal failure is also a condition where green tea has shown to have protective effects. Decreased kidney function due to aging and kidney failure are a frequent cause of death. A preliminary study in Mansoura University in Egypt has explored the possibility to protect kidney function from life threatening failure with the frequent use of green tea. They found that animals with kidney failure when treated with 50mg/kg EGCG from green tea showed significantly recovered glomerular filtration rate in 7 days, reduced melanode-aldehyde and inflammatory cytokines and increased glutathione (antioxidant levels) as compared to resveratrol and quercetin. The study indicate that in streptozotocin (STZ)-induced diabetic nephropathy, kidney function appears to be improved with green tea (GT) consumption which also prevents glycogen accumulation in the renal tubules, probably by lowering blood levels of glucose. Therefore, GT could be beneficial additional therapy in the management of diabetic nephropathy.

Improves insulin sensitivity:

The green tea has an antidiabetic effect. Its consumption has shown to bring alteration in metabolic response and cardiovascular autonomic modulation in STZ (Streptozotocin)-induced diabetic rats. STZ destroys pancreatic β cells, resulting in a diabetic syndrome in animals, similar to that seen in human type-1 diabetes and characterized by hyperglycemia, hypoinsulinemia, glucosuria, and loss in body weight. Population studies suggest that green tea consumption may help prevent type 2 diabetes. It improves glucose tolerance and insulin sensitivity in individuals with 2 diabetes. In a study, after receiving green tea for 12 weeks, diabetic rats had lower fasting blood levels of glucose, insulin, triglycerides and free fatty acids compared to controls, and the ability of their adipocytes to respond to insulin and absorb blood sugar greatly increased[19].

Protects against cardiovascular diseases:

Another gem associated with green tea is its ability to protect from cardiovascular diseases. Heart diseases and stroke are associated with a number of risk factors and are most prevalent in the Western world, probably as a result of the lifestyle in this part of the world, which includes a diet high in saturated fats and low physical activity, and the large proportion of the population who smoke cigarettes and have high blood pressure. Green tea appears to be cardioprotective. Regular consuming green tea also inhibits atherosclerosis. Ground green tea consumption decreased susceptibility of plasma and LDL to oxidation and also modulated cholesterol metabolism and might prevent initiation and progression of atherosclerosis. Green tea has been shown to effectively lower LDL Cholesterol, triglycerides, lipid peroxides and fibrinogen while improving the ratio of bad / good cholesterol i.e. Ratio of LDL to HDL cholesterol²[20].

DISCUSSION:

Human population growth, technological advances, and changing social behaviours lead to the selection of new microbial pathogens. Emerging infectious diseases are caused by new or previously unrecognized microorganisms. By going through and reviewing various articles, we found that green tea can be used as an excellent antimicrobial agent. Green tea extracts are infused in various dosage forms such as creams, gels, ointments, lotions and taken in the form of decoction itself.

CONCLUSION:

Currently there has been an increased interest globally to identify antioxidant potentials of green tea which is pharmacologically potent and have low or no side effects for use in protective medicine and the food Industry. The credit for this remarkable achievement is linked with the high antioxidant components of green tea. From antibacterial to antifungal, antiviral potentials, from skin, vision, hair loss, over weight issues, diabetes, kidney disorders, to Parkinson's and Alzheimer's disease, cancer and many more, green tea has proved its potentials and still many parameters are still need to be explored. Identification of active principal, screening of bio medicinal properties by appropriate in vitro assays, investigation of toxicological effects as per the regulatory guidelines will make green tea a magical herb with miraculous outcomes. There is an increasing interest in the health benefits of green tea in the field of oral health. The non tea drinkers can switch over to green tea oral care products and the ones who relish their cup of tea should turn on the kettle to brew the green tea only. However, although all the evidence from research on green tea is very promising, future studies are necessary to fully understand its contributions to human health.

REFERENCES:

1. Gomikawa, S, Ishikawa Y, Hayase W, Haratake Y, Hirano N, Matuura H, Mizowaki A, Murakami A, Yamamoto M. Effect of ground green tea drinking for 2 weeks on the susceptibility of plasma and LDL to the oxidation ex vivo in healthy volunteers. *Kobe Journal of Medical Science*, 2008; 54(1):E62-72.
2. Hicks A. Review of Global Tea Production and the Impact on Industry of the Asian Economic Situation. *AU Journal of Technology*, 2001; 5(2):252-258.
3. Milind P, Nitin B, Seema B. Is life- span under our control?? *International Research Journal of Pharmacy*, 2012; 2:40-48.
4. McNaught JG. On the action of cold or lukewarm tea on *Bacillus typhosus*. *Journal of the Royal Army Medical Corps*, 1906; 7:372-373.
5. Archana S, Jayanthi A. Comparative analysis of antimicrobial activity of leaf extract from fresh green tea, commercial green tea and black tea on pathogens. *Journal of Applied Pharmaceutical Science*, 2011; 01(08): 149-52.
6. McKay DL, Blumberg JB. The role of tea in human health: An update. *Journal of the American College of Nutrition*, 2002; 21:1-13.

7. Rietveld A, Wiseman S. Antioxidant effects of tea: Evidence from human clinical trials. *The Journal of Nutrition*, 2003; 133:3275–3284.
8. Il'yasova D, Martin C, Sandler RS. Tea intake and risk of colon cancer in African-Americans and Whites: North Carolina colon cancer study. *Cancer Causes and Control*, 2003; 14: 676–772.
9. Tariq M, Naveed A, Barkat AK. The morphology, characteristics, and medicinal properties of *Camellia sinensis*' tea. *Journal of medicinal plants research*, 2010; 4(19):2028-2033.
10. Horzic D , Komes D , Belacak A, Ganic KK, Ivekovic D , Karlovic D. The composition of polyphenols and methylxanthine in teas and herbal infusions. *Food Chemistry*, 2009; 115:441-448.
11. Hakim I, Harris R, Weisgerber U. Tea intake and squamous cell carcinoma of the skin: Influence of type of tea beverages. *Cancer Epidemiology Biomarkers and Prevention*, 2000; 9:727– 731.
12. Wu CD, Wei GX. Tea as a functional food for oral health. *Nutrition*, 2002; 18:443–444.
13. Cabrera C, Reyes A, Rafael G. Beneficial Effects of Green Tea—A Review. *Journal of the American College of Nutrition*, 2006; 25(2):79-99.
14. Hamilton, Miller, Shah S. Activity of the tea component epicatechin gallate and analogues against methicillin-resistant *Staphylococcus aureus*. *Journal of Antimicrobial Chemotherapy*, 1999; 46(5):852-853.
15. Abdolhosein M , Ahma F, Aghel N , Agheli H , Raisi N.: The Effect of Green Tea on Prevention of Mouth Bacterial Infection, Halitosis, and Plaque formation on teeth. *Iranian Journal of Toxicology*, 2011; 5(14): 502- 515.
16. Mageed J , Mays, Jum S S.: Antimicrobial effects of green tea extracts on *Porphyromonas Gingivalis* (in vitro study). *IOSR Journal of Dental and Medical Sciences*, 2015; 14(10):33-39.
17. Masatomo H, Kazuko T. Multiple effects of green tea catechin on the antifungal activity of antimycotics against *Candida albicans*. *Journal of Antimicrobial Chemotherapy*, 2004; 53(2):225-229.
18. Mbata TI, Debiao L, Saikia A. Antibacterial activity of the crude extracts of Chinese Green Tea (*Camellia sinensis*) On *Listeria monocytogenes*. *The Internet Journal of Microbiology*. 2006; 2(2):48.
19. Ping S, Anders H , Christina N, Hazel M. Synergistic effect of green tea extract and probiotics on the pathogenic bacteria, *Staphylococcus aureus* and *Streptococcus pyogenes*. *Journal of Microbiology and biotechnology*, 2008; 24:1837-1842.
20. Singleton VL, Rossi JA. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. *American Journal of Enology and Viticulture*. 1965; 16:144–158.