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A CLINICAL REVIEW OF GREEN TEA AS ANTIBACTERIAL ACTIVITY

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ABSTRACT

Plant extracts have been widely used as topical applications for wound-healing, anti-aging, and disease treatments. The tea plant(camellia sinensis) is widely used as antioxidant and have antimicrobial effects against various pathogenic bacteria's. Tea can be cultivated in various regions sea level to highest mountains. Green tea crude extracts was prepared from their leaves. Tea are anti-inflammatory agents that inhibit clinical Symptoms of UTIs. Green tea crude extracts are also used to prevent against uropathogens, widely used in recent years as it is the most common type of Nosocomial infection in females and males, and have resulted in Billions of dollars in medical care costs. Green tea is also effective against skin pathogens that are widely spread in America, recently. Green tea is also used for their antimicrobial property, effective against harmful microbial bacteria's inside the body. The reviewed herbs are safe and further research is required to Examine their efficacy, safety and potential drug interactions.

KEYWORDS: Antibacterial, antioxidant, anti-inflammatory agents, skin pathogens, uropathogens.

INTRODUCTION

The tea plant (Camellia sinensis) has been cultivated in Asia for thousands of years. Currently, more than two thirds of the world population consumes this his popular beverage. However, the majority of the tea consumed in the world is black tea (78%), Whereas green tea consumption comprises only 20%.[14] China is the second largest tea producer in The

world, but is the largest producer and consumer Of green tea. The unique feature of green tea production is that the processing of the tea leaves does not involve any form of fermentation. Freshly picked Tea leaves are briefly heated in a pan or by steam Without any additives. The brief heating inactivates Polyphenol oxidase, thereby preserving the antioxidant activities of the polyphenols. The 4 major Polyphenolic catechins present in green tea leaves are (2)-epicatechin (EC), EGC, (2)-EC-3-gallate, and EGCG, which is the most abundant.[7,8,11] The total Content of polyphenols in tea leaves varies from Approximately 20% to 40%, depending on the subspecies of the plant and geographic location. The Polyphenols are readily extracted from green tea Leaves by water or organic solvents such as methanol and ethanol.

Camellia sinensis is one of the most popular beverages in the world, and has been reported to have antimicrobial effects against various pathogenic bacteria.[6,10,12,24] Tea can cultivated in many regions from sea level to high mountains. It is generally safe, nontoxic, cheap, and available and is a popular drink, Traditionally in Asian countries.[3,4] These properties make it a very Good alternative antimicrobial agent. For green tea production, freshly harvested tea leaves of C. sinensis must be processed with the least amount of oxidation, while oolong and black tea are made from fermented leaves of the same plant. Studies on the antibacterial activity have shown that green tea inhibits the growth of E. coli by its polyphenolic components (also known as catechins).

Antibacterial activity of Camellia sinensis (green tea) crude extract was determined against multi-drug resistant pathogens. In this study multidrug resistant E. coli and S. aureus and their reference strains were used for screening antibacterial activity of green tea.

Green tea crude extract was prepared from the dried leaves. Catechins Were also extracted and epigallocatechin was separated from green tea Plants. Green tea and the purified compound have shown good inhibitory And bactericidal effect on the MDR pathogens. In our study green tea Inhibits the drug resistant pathogen at 125 µg/mL. This was the minimum concentration at which green tea extract inhibited the pathogen. In Another study, the antibacterial effects of tea polyphenols (TPP) extracted from Korean green tea (Camellia sinensis) have been found against Clinical isolates of methicillin-resistant Staphylococcus aureus (MRSA) (Archana and Abraham, 2011). In present study, green tea extract Showed MBC at 500µg/mL against MDR S. aureus but no MBC was found Against MDR E. coli. So, we can tell that green tea extract has shown Better bactericidal effect on Gram positive pathogen than Gram negative Pathogen. Previous studies have reported that catechins from

green tea Are active against Gram positive bacteria (Yam et al., 1997) but no effect Was seen to be antimicrobial against Gram negative bacteria. This was May be due to their different cell wall components.

The different mechanisms of green tea

1. Tea. are anti-inflammatory agents that inhibit clinical Symptoms of UTIs.[7,26]
2. Catechins induce production of cytokines such as IL-12 and IL- 10.[7]
3. Green tea polyphenols decrease tumor necrosis factor-a gene expression, which is important in pathogenesis of E. coli Infection.[7]
4. Catechins, by blocking the connection of conjugated R plasmid In E. coli, have bactericidal and antitoxin effects.[7]
5. Catechins-copper (II) complexes damage the cytoplasmic membrane of E. coli.[28,30]
6. EGC can bind to the ATP site of the DNA gyrase b subunit of Bacteria and inhibit the activity of the gyrase enzyme.[7,28]
7. The bactericidal action of catechin is due to its hydrogen Peroxide generation.[29]
8. The highest antimicrobial activity of tea is due to presence ofbCatechins and polyphenols which damage the bacterial cell Membrane.[30]
9. Catechins interfere with the expression of b-lactamases in Staphylococci and inhibit the extracellular release of Vero toxin From enterohemorrhagic E. coli (EHEC) 0157.[27,31]

Several research studies have focused on the effects of green tea on microorganisms. In the present review, the antimicrobial effect Of green tea on E. coli (the major pathogen of UTI) is discussed in.

Green tea as skin Pathogen

Skin has the largest epithelial surface of all organs, And skin cancer is the most common type of cancer In the United States according to the CDC.1 Excluding melanoma, the incidence of basal cell carcinoma And squamous cell carcinoma of skin is estimated to Exceed 1 million per year.17 On the other hand, skin Cancers are among the most preventable, because.

The primary cause of these malignancies is shortwave UV radiation from the sun. GTPPs were first found to Prevent skin cancer in a chemical-induced skin cancer model. During the late 1980s, a group headed By Hasan Mukhtar18 at Case Western Reserve University (Cleveland, Ohio) applied GTPPs topically on Sencar mice at a dose of 24 mg/mouse for 7 days Before exposure to a single dose of 200 nmol of the Initiating agent, (1/2)-7 b, 8 a-

dihydroxy-9 a,10 aepoxy-7,8,9,10-tetrahydrobenzo[a]pyrene. This was Followed by topical applications twice weekly of the Tumor promoter TPA. Results showed that GTPPs Had a significant inhibitory effect on tumor induction In this initiation-promotion model.18 These investigators also tested topical application of GTPPs in a Complete skin tumorigenesis protocol using 3-methylcholanthrene on BALB/c mice, and a two-stage Skin tumorigenesis protocol using DMBA as the Initiating agent and TPA as tumor promoter with Sencar mice. Significant protection by GTPPs against Skin tumorigenicity was demonstrated.19 These findings represent the first topical application of GTPPs For protection from skin cancer and served as a Foundation for subsequent studies. A mechanistic Study of GTPPs' protective effect followed, which Showed that the antioxidant activity of GTPPs could Be responsible for the anticarcinogenic potential Against TPA and free radicals.20 It was later found That EGCG was a potent anticarcinogen in a chemically induced cutaneous cancer model. EGCG significantly inhibited binding of 3H-labeled polycyclic Aromatic hydrocarbons to epidermal DNA. Topical Pretreatment of mice with EGCG resulted in significant reduction in tumor size and number per mouse In a DMBA tumor-initiation model.[21]

The first UVB radiation-induced photo carcinogenesis study using GTPPs as a protection agent was reported 2 years later by Mukhtar and colleagues.22 SKH-1 hairless mice were either fed 0.1% GTPPs or GTPPs were topically applied, followed By exposure to UVB radiation. Both applications Afforded photo protection against UVB.

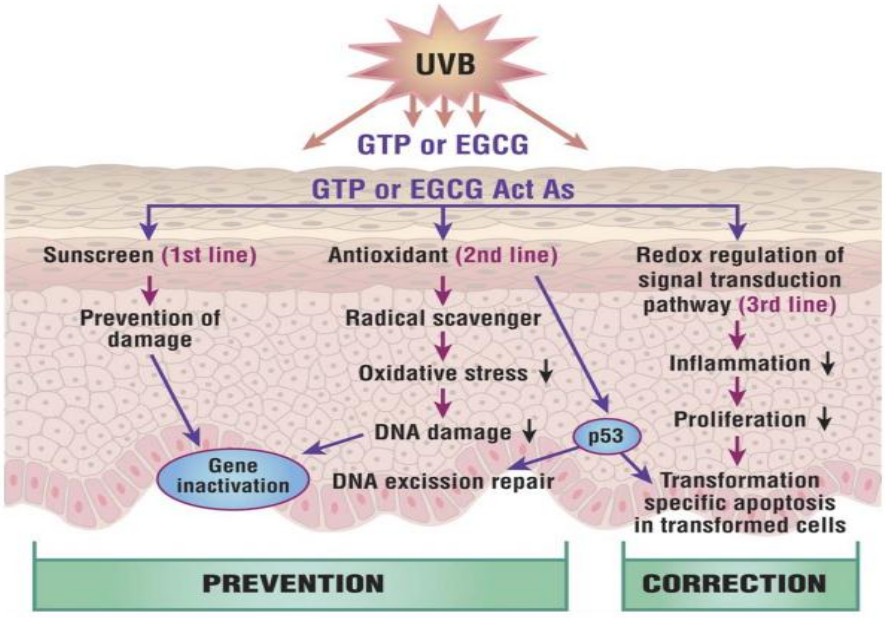

Fig 1. Schematic illustration of properties of green tea in photoprotection against UV irradiation, summarized from previously published data.[4,35,41,52,59,69,70] Only epidermis is shown. *EGCG*, (−)- Epigallocatechin-3-gallate; *GTP*, green tea polyphenol.

Green tea as Uropathogens

Urinary tract infections (UTIs) are the most common type of Nosocomial infection in females and males, and have resulted in Billions of dollars in medical care costs.[1,2] The most important cause Of 80e90% of all UTIs is Escherichia coli.3 Nonpathogenic strains of E. coli are important facultative aerobes in the normal intestinal Flora of human and animals. However, pathogenic strains of these Bacteria are the most common cause of urinary tract infections.[4] Uropathogenic E. coli infects the urinary tract by producing special surface proteins (adhesins), which make them to attach to and Attack the epithelial cells that line the urinary bladder.[5] If pathogenic E. coli is in the bladder (uncomplicated UTI), and is not eliminated, it may travel up the ureters to the kidneys and cause Complicated UTIs which can be accompanied by renal damage and Renal failure.

Hoshino et al28 studied the effect of catechins (EGC and EC)- Copper (II) complexes on the cytoplasmic membrane ofi.E. coli were incubated with EGC in the presence of Cu2þ at 37C and,After 60 minutes, the supernatant was separated by centrifuging And the copper concentration of the supernatant (using atomic Absorption with a Shimadzu spectrophotometer, Kyoto, Japan AA- 660) and also the amount of copper ions binding to E. coli cells were determined. They concluded that EGC and EC (100 mM each) And Cu2þ (1 mM) separately have no effect on the viability of E. coli,While the combination of Cu2þ (1 mM) with EGC (1 mM, 10 mM, and 100 mM) or EC (100 mM) killed E. coli cells. To determine ATP levels in E. coli cells, they incubated E. coli with EGC or EC in the presence of Cu2þfor 60 minutes at 37C and ATP (using an ATP bioluminescence Assay kit based on the method of Stanley) and cellular and unbinding potassium levels (using atomic absorption) were measured. To analyze DNA of E. coli cells, first they isolated DNA from E. coli Cells and then incubated it with EGC or EC in the presence of Cu2þ For 60 minutes at 37C. They found that the DNA double strands did Not break in the killing process, while depletion in both the ATP and Potassium pools of the had an important role in killing of E. coli. Therefore, bactericidal activity of catechins in the presence of Cu2þ Is derived from damage to the cytoplasmic membrane of E. coli.[28]

Anti bacterial properties of green tea

Drug resistance and side effects encountered with the use Of synthetic drugs has led to the surge for novel and safe Alternatives.[4] Since ancient times, plants have proved to be An archetypal source of medicine. Camellia sinensis is a shrub Of the Theaceae family usually

clipped to a height of 2–5 feet In cultivation, grown in semi-tropical environment.[12] Leaves are usually handpicked and based on the processing of the Leaves three different types of tea are produced, namely Green Tea (non-fermented), Oolong tea (semi-fermented) and Black Tea (fermented).[13] Green tea being the non-fermented type Possess more Catechin than the other two types.[4] Green Tea has antioxidant, antiviral and antitumoral properties.[4,5] Despite abundant literature on the general health benefits of Drinking green tea exists, its effect on cariogenic microbes is Limited. With this background, the present study was carried Out to determine the in vitro antibacterial effect of C. sinensis Extract on S. mutans and L. acidophilus.

The Inhibitory zones increased with increasing volumes of green Tea ethanol extracts. It is remarkable to note that greater zone Of inhibition was obtained for 300 µg/ml of green tea than Chlorhexidine against both S. mutans and L. acidophilus. As With any in vitro studies this study is not without limitations. This study has been performed in planktonic cultures of Mutans and L. acidophilus. In vivo studies in this area are Further required as limited data are available regarding their Biofilm counterpart. Hence, further studies are required for Understanding antimicrobial effect of green tea extract in biofilm.

Jazani et al39 evaluated the synergistic effect of water-soluble Green tea extract on the activity of ciprofloxacin against isolated E. coli. During a 2-month period, they collected 18 isolates from Urine specimens submitted to a clinical diagnostic laboratory in Urmia, Iran. They used water soluble green tea extract (2% tea Extract was prepared following the method described by Tiwari Et al37) and determined MIC and MBC of bacterial isolates for Measuring antimicrobial activity of green tea extracts and cipFloxacin. The mean of MBC and MIC for all 18 isolates were 122.9 ± 40.3 mg/mL. To determine the synergistic activity of greenbTea water extract with ciprofloxacin, they used a sub-MIC concentration of ciprofloxacin. Each dilution RT owas inoculated with 3 106 CFU/mL of bacteria. After overnight incubation, they Measured MIC and MBC of green tea extract in the presence of Ciprofloxacin. There was a reduction in MIC of green tea extracts in The presence of sub-MIC doses of ciprofloxacin, for 93.7% (15 of 16 Tested) of bacterial isolates.

CONCLUSION

Green tea is used as a antibacterial activity of various pathogenic bacteria's inside the body. As a uropathogens, skin pathogens E.coli is a most common cause of UTI infection. The

development of antibiotics resistance in E. Coli is an important problem. Camellia sinensis is a safe non toxic, cheap beverage.

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