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Review Article

Camellia sinensis on plaque and gingivitis

*Dr. Mohan krishna Bondili [1], Dr. Adusumilli Srikanth [2], Dr. Devathi Sreenidhi [3]

[1,3] MDS, Drs. Sudha and Nageswara Rao Siddhartha Institute of Dental Sciences, Chinnaoutpalli Gannavaram Mandal, ANDHRA Pradesh pin code – 521101
[2] PROFESSOR, MDS, Drs. Sudha and Nageswara Rao Siddhartha Institute of Dental Sciences, Chinnaoutpalli Gannavaram Mandal, ANDHRA Pradesh pin code – 521101

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Corresponding author: Dr. Mohan krishna Bondili
MDS, Drs. Sudha and Nageswara Rao Siddhartha Institute of Dental Sciences, Chinnaoutpalli Gannavaram Mandal, ANDHRA Pradesh pin code - 521101

Abstract
Gingivitis is inflammation of gingiva induced by bacterial biofilm, plaque adherent to tooth surface. However, need for chemotherapeutic agents has been prompted by normal adult population's incapacity of performing proper brushing. chlorhexidine, phenols, cetylpyridium, triclosan, and tetracycline have been utilized in several forms like mouthrinses, toothpaste, local drug delivery etc. Market for herbal products in oral care is expanding. Camellia sinensis commonly called green tea have antiseptic, antioxidative properties and its aromatic constituents exhibit anti-inflammatory and antibacterial properties of green tea catechins at site of inflammation (epigallocatechin and epicatechin) have reported it to be efficacious and further eliminate foul breath by promoting anaerobic bacteria and stop producing volatile sulfuric compounds. In comparison to other mouthwashes, the purpose of this research was to assess existing data on effectiveness of green tea-based mouthwashes in treating dental plaque and gingivitis in systemic manner.

Keywords: *Dental plaque, Gingivitis, Herbal products.*

Introduction
Gingivitis is defined as infection or inflammation of gingiva caused by bacterial accumulation. It mainly occurs because of plaque accumulation, and factors responsible for accumulation poor dental and oral hygiene. If treated promptly, gingivitis, an early-stage gum disease, can be reversed. It causes gums to turn swollen, red, and prone to bleeding, sometimes triggered by brushing or even occurring spontaneously. While mechanical cleaning methods, like regular brushing and flossing, are proven to be effective for controlling plaque and managing gingivitis, many people struggle with proper technique or consistency. Because of this, adding chemical agents such as chlorhexidine and triclosan has proven to be a helpful addition to improve oral hygiene outcomes.

Despite being the gold standard for oral care, effectiveness of chlorhexidine typically lasts only about 10 - 12hrs. It also comes with several common side effects, including staining of the teeth and mouth, increased tartar buildup, mouth ulcers, altered or reduced sense of taste, white patches or sores, swollen salivary glands, and, in some cases, allergic reactions like trouble in breathing or swelling of face, throat, tongue, or lips.

Because of these drawbacks, there is a growing need for a natural, locally available, and affordable alternative that offers similar benefits but with fewer side effects.

Herbal medicines, which originate from botanical sources, have long been utilized in dentistry to alleviate pain, soothe irritation, reduce inflammation, and inhibit microorganisms. Recently, it has been discovered that many herbal mouthwashes have demonstrated promising outcomes in management of gingivitis and plaque.

Herbal mouthwashes are formulated using essential oils and extracts from medicinal plants. These natural products contain active compounds like catechins, tannins, and sterols, which work together to provide gentle and effective healing benefits. The combination of these plant-derived substances offers a mild yet therapeutic approach to oral care.

Plants have long been recognized for their medicinal properties, and many studies have explored their therapeutic potential. One such plant, used since ancient times, is tea (*Camellia sinensis*). Studies have indicated that tea, especially green tea, offers a range of health benefits, largely due to its rich content of polyphenols found in the leaves.

In recent years, green tea has gained worldwide attention, largely due to its high content of naturally preserved polyphenols—a group of plant-based compounds that includes flavonoids, phenolic acids, and lignans. These compounds are known for their powerful health-promoting properties.

Green tea offers a wide range of benefits, including antiviral, antibacterial, and anti-inflammatory effects. Studies have also linked it to a reduced risk of cancer and improved brain function. Beyond that, green tea has been associated with neuroprotective and anti-anxiety effects, as well as benefits for heart health, cholesterol management, arthritis relief, and the prevention of abnormal blood vessel growth (antiangiogenic activity).

Green tea extracts contain varying amounts of polyphenols, ranging from 45% to 90%, and caffeine levels between 0.4% and 10%. In comparison to black and oolong teas, green tea has higher concentration of major flavonoids.

Research Methodology

Date and source of data

For this study, secondary data has been collected from the textbooks of Carranza's clinical periodontology, Lindhe, and from different journals and from websites such as SCOPUS, PUBMED, and WEB OF SCIENCE.

Theoretical framework

According to American Dental Association, mouthwashes should be able to change microbiota by carefully removing pathogens without affecting oral cavity's normal commensals.

Green Tea: Unlike black tea's fully fermented leaves and oolong tea's partially fermented leaves, it is made from unfermented leaves.

Fluoride and bioactive component called catechin, abundant in green tea, have anti-cariogenic properties through inhibiting growth of streptococcal agents, preventing bacteria from adhering to tooth surface enamel, and acting as glucosyltransferase as well as amylase inhibitors.

Different types of tea has been introduced.

i) Green tea: Green tea mouthwash is just as effective as chlorhexidine, widely regarded as gold standard in oral care. Beyond its effectiveness, green tea offers an affordable option that could serve as a valuable public health tool. It contains a variety of beneficial compounds that provide multiple health benefits, making it a natural and cost-effective choice for supporting overall well-being.

ii) ii Black Tea: Roughly 72% of world's total tea production comes from there. Fermentation process oxidizes majority of EGCG antioxidants, while black tea retains a significant amount of flavonoids and other antioxidant polyphenols. These antioxidants assist in body's detoxification.

iii) iii White Tea: Buds and young tea leaves have been carefully picked before buds open. They are then steamed and dried with minimal processing. Because of this gentle handling, white tea preserves highest levels of antioxidants and contains less caffeine in contrast to other teas, notably black, green, or oolong, all of which come from *Camellia sinensis* plant.

iv) Oolong Tea: Partially fermented, oolong tea possesses health benefits and flavor of black and green teas. Its strong antioxidant content slows down aging process and preserves healthy skin cells.

v) Pu'erh Tea: This kind of tea must be harvested all year round and is prepared from large-leaf tea plant. While its processing shares similarities with black tea, aging process sets it apart after being picked, leaves are carefully piled and left to mature, sometimes for as long as 50 to 100years. This long aging period gives tea its distinct character and depth of flavor.

Green Tea Types

1. Fresh leaves are dried and steamed to inactivate polyphenol oxidase by non-oxidation, resulting in nonfermented green tea.
2. Partial fermentation of fresh leaves prior to drying results in semi-fermented oolong tea.
3. Red and black tea that has been fermented after harvest and then dried and steamed.

Beneficial effects of various tea components (catechins)

Antioxidative effect

Green tea's antioxidant effects come from its ability to neutralize reactive oxygen and nitrogen species, as well as its capacity to bind with redox-active metals like iron and copper. It also helps by blocking pro-oxidant enzymes, influencing redox-sensitive transcription factors, along with boosting the activity of antioxidant enzymes. These protective actions are largely due to catechins, which interact with the structure of cell membranes, particularly the phospholipid layer, helping to maintain cellular balance and defense.

Antimicrobial effect

Methicillin-resistant α-hemolytic Streptococcus, Helicobacter pylori, and Staphylococcus aureus are three main antibacterial agents that are affected by epicatechin gallate, epigallocatechin, and epigallocatechin gallate.

Anticariogenic effect

Catechins help prevent tooth decay by effectively inhibiting growth of Streptococcus mutans and Streptococcus sobrinus, even at low concentrations ranging from 50 to 1000µg/ml.

Preparation of Camellia sinensis mouthwash

Green tea mouthwash was prepared using leaves from *Camellia sinensis* plant. Leaves were chopped and broken into small pieces, and 100g of this plant material were soaked in 500ml of methanol for 48hrs to extract active compounds. To measure total phenolic content in hydroalcoholic extract, Folin-Ciocalteu method has been utilized. 0.25ml of Folin reagent was combined with 0.1ml of extract sample. After allowing mixture to sit for 5 minutes, after adding 20% sodium carbonate solution, everything was shaken well. Incubation of mixture for 40min at room temperature followed, and absorbance was determined at 725nm employing PerkinElmer double-beam UV-Visible spectrophotometer. A calibration curve has been created using standard concentrations of tannic acid, and the findings were presented as equivalents of tannic acid. Aluminum chloride colorimetric method has been utilized for assessing total flavonoid content. In this process, 0.5ml methanolic extract had been combined with 1.5ml methanol, 00.1ml of 1M potassium acetate, .1ml 10% aluminum chloride in methanol, and 2.8ml of distilled water. Absorbance at 415nm has been calculated following 30-min incubation period at room temperature. A calibration curve has been generated utilizing standard concentrations of quercetin in methanol, and flavonoid content was reported with regard to quercetin equivalents.

Conclusion

Green tea mouthwash is more effective than chlorhexidine in minimizing severe levels of gingivitis. Additionally, it contributes favorably to maintaining overall oral health because of its natural healing properties.

Considering its anti-inflammatory, antimicrobial, and antioxidant properties, green tea can be a beneficial part of your daily oral care routine. Because it's affordable and easy to find locally, a green tea herbal extract mouthwash offers a practical alternative to chlorhexidine after periodontal surgery. It supports healing and is generally well-tolerated, with no notable side effects.

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