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(REVIEW ARTICLE)

The Utilization of Herbal Tea as an Inhibitory Agent Against *Candida albicans* Growth in the Oral Cavity

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Abstract

Candida albicans is one of the major pathogenic microorganisms in the oral cavity and is responsible for the development of oral candidiasis. This fungus can proliferate and cause infection within the oral environment, and its growth must be controlled to prevent further oral complications. Oral candidiasis is an opportunistic infection of the oral cavity caused by *C. albicans* and is commonly associated with local or systemic immune suppression. Predisposing factors include extremes of age (newborns and the elderly), immunocompromising conditions such as HIV/AIDS, and prolonged use of systemic steroids or antibiotics. This study aims to review the effectiveness of herbal tea–based ingredients, namely green tea, bush tea, and Mongolian herbal tea, in inhibiting the growth of *C. albicans* in the oral cavity. Oral candidiasis can generally be prevented through the use of mouthwashes that inhibit the proliferation of *Candida* species. Sodium fluoride mouthwash is widely used for routine oral hygiene in home care settings. Numerous studies have demonstrated that fluoride interferes with carbohydrate metabolism in cariogenic microorganisms and promotes the remineralization of demineralized tooth structures; consequently, sodium fluoride has become the compound of choice in many oral health prevention programs. Despite these advantages, concerns have been raised regarding the risk of fluoride ingestion in children, which may lead to fluoride toxicity. To overcome the limitations associated with chemical-based products, various natural and herbal mouthwashes have been introduced. Among herbal products reported in the scientific literature, green tea has traditionally been used as an effective therapeutic agent for the management of candidiasis.

Keywords: *Candida Albicans*; Candidiasis; Herbal Tea; Mouthwash

1. Introduction

Candida albicans is a pathogenic fungus commonly found in the oral cavity. It is believed to be one of the main causative agents of oral candidiasis, accounting for approximately 50% of all cases [34]. Within the oral environment, C. albicans constitutes nearly 80% of the Candida species and remains the most prevalent and essential pathogenic agent. Mouthwashes, which function as breath fresheners, medications, and antiseptics, can serve as oral therapeutic agents [6]. Antifungal mouthwashes can deliver therapeutic agents to accessible interproximal hard and soft tissues [2], exhibit generally fewer side effects, present a low risk of resistance, and are safe for routine use [27]. Currently, various mouthwash formulations are available for both preventive and therapeutic purposes in managing oral diseases [18]. Mouthwashes are generally safe and contain active compounds that can significantly reduce or eliminate plaque accumulation [12]. Since most individuals do not brush their teeth adequately, mouthwash can be considered an alternative tool for oral hygiene and daily application [21].

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Previous studies have investigated herbal tea-based mouthwashes and their effects on Candida albicans, including *Salvadora persica* and *Matricaria chamomilla* [29], as well as in vitro evaluations of mouthwash formulations derived from *S. persica*, *Terminalia bellerica*, *Piper betle*, *Gossia fragrantissima*, *Elettaria cardamomum*, *Mentha* spp., and *Trachyspermum* species against C. albicans [22].

Tea in general is non-toxic and safe, and has been shown to possess antioxidant and anti-inflammatory properties [20]. Based on the manufacturing process, tea is classified into three categories: non-fermented (green tea and white tea), semi-fermented (oolong tea), and fermented (black tea and red tea), although all are derived from the same plant species [26]. Moreover, herbal plants have long been recognized as sources of diverse bioactive compounds with antimicrobial properties [24]. In vitro studies have shown that plants rich in secondary metabolites such as tannins, terpenoids, alkaloids, and flavonoids exhibit antimicrobial activity [23]. The presence of metabolites such as saponins, tannins, alkaloids, flavonoids, steroids, and cardiac glycosides in medicinal plants further highlights their pharmacological significance [27].

The antimicrobial effects of tea polyphenols have been widely studied. The antifungal activity of herbal teas against C. albicans has been demonstrated in *Anji white tea* (white tea), *Tie Guan Yin* (oolong tea), and *Da Hong Pao* (oolong tea), which exhibit measurable minimum inhibitory concentrations [5]. The polyphenols of black tea (catechins and theaflavins) have also been shown to inhibit the growth of C. albicans [24]. In addition, several herbal plants such as *Rosa acicularis*, *Vaccinium vitis-idaea*, *Betula platyphylla*, *Taraxacum officinale*, and *Plantago major* contain a wide variety of polyphenols, including catechins, as well as glucose and ascorbic acid [33].

Therefore, this review aims to highlight the effects of mouthwash formulations derived from various herbal teas—such as green tea, bush tea, and Mongolian herbal tea—on the growth inhibition of Candida albicans in the oral cavity.

2. Material and methods

The method used in this study was a literature review approach. Relevant scientific articles were collected and analyzed to evaluate the antifungal potential of herbal teas, particularly green tea (*Camellia sinensis*) and bush tea (*Athrixia phylicoides*), against *Candida albicans*. This review focused on clinical manifestations of oral candidiasis, antifungal mechanisms of catechins and polyphenols, laboratory evaluation methods, and the formulation of herbal mouthwash preparations. Through this approach, the study aimed to summarize recent findings related to the inhibitory effects of herbal extracts on *Candida albicans* growth.

2.1. Oral Candidiasis and Herbal Antifungal Agents

Patients infected with oral candidiasis commonly experience clinical manifestations such as mucosal inflammation, pain, erosions, dysphagia, and hyperplasia of the oral mucosa. If left untreated, *Candida albicans* may disseminate to other organs and tissues. To prevent this spread, non-toxic herbal extracts have been introduced as alternative therapeutic agents. Several studies have reported that herbal teas possess strong antifungal properties, with green tea and bush tea demonstrating significant inhibitory effects against *C. albicans* [33, 35].

2.2. Polyphenol, Tannin, and Antioxidant Analysis

Total polyphenol content was determined using the Folin–Ciocalteu colorimetric assay adapted from established protocols [31,18]. Tannin concentration in the extracts was quantified using vanillin-HCl based colourimetric methods as described in recent analytical reviews [18]. Total antioxidant capacity was assessed using validated radical scavenging and reducing power assays, including DPPH and FRAP, in accordance with tea polyphenolic analysis methods reported in the literature [27].

2.3. Antimicrobial Activity Testing

The minimum inhibitory concentration (MIC) and minimum microbicidal concentration (MMC) of herbal extracts are determined using the microdilution technique in 96-well microplates, as described by Eloff (1998). Microbial strains evaluated include Gram-negative bacteria (*Escherichia coli, Klebsiella oxytoca, Proteus vulgaris, Serratia marcescens, Salmonella typhi,* and *Klebsiella pneumoniae*), Gram-positive bacteria (*Bacillus cereus* and *Staphylococcus aureus*), and the fungus *Candida albicans* [32].

2.4. Mechanism of Catechin Antimicrobial Activity

The antimicrobial activity of catechins is mainly attributed to their ability to disrupt microbial cell membranes. Previous studies have demonstrated that catechins induce membrane destabilization by causing leakage of intracellular

components, leading to microbial cell damage and death. This activity is closely associated with the presence of hydroxyl groups and gallic acid in catechin structures, which enhance their interaction with microbial cell membranes [24,26]. Studies evaluating tea extracts have also reported that catechins exhibit antifungal activity against *Candida albicans* through similar mechanisms of membrane disruption [5, 13].

2.5. Preparation of Herbal Mouthwash Formulation

Green tea (*Camellia sinensis*) and bush tea (*Athrixia phylicoides*) leaves are air-dried and ground into fine particles prior to extraction. Extraction is carried out using double-distilled water as the solvent. Green tea extract, which contains high levels of phenolic compounds, is diluted to achieve a phenol concentration of 0.5%. Peppermint flavoring (1 g/L) and sodium saccharin (1 g/L) are added to the formulation to improve palatability. Green tea is particularly rich in catechins, especially epigallocatechin gallate (EGCG), which exhibits strong antioxidant and antimicrobial properties [8,10,15]

2.6. Therapeutic Potential of Green Tea and Bush Tea

Both green tea and bush tea contain polyphenols and catechins that contribute to their antimicrobial and antifungal activities. However, green tea has been reported to contain higher concentrations of these bioactive compounds compared to bush tea [26, 32]. Several studies have demonstrated that regular use of green tea and herbal teas effectively inhibits the growth of *Candida albicans*, supporting their potential application as alternative herbal mouthwashes for oral health management [9, 18, 29].

3. Results and discussion

3.1. Polyphenols and Antifungal Activity of Herbal Teas

The potential healing effects of herbal plants have long been recognized, and in recent years have gained renewed scientific attention. Herbal teas contain various bioactive compounds that contribute to health promotion and are widely used for medicinal purposes [15]. Among these compounds, tea polyphenols have been demonstrated to exhibit inhibitory effects on fungal growth, including Candida albicans [9]. Polyphenols are aromatic hydroxylated compounds and are considered among the most potent bioactive substances with therapeutic potential [3].

3.2. Characteristics of Candida albicans and Tea Polyphenol Mechanisms

Candida albicans is a pleomorphic microorganism capable of adopting multiple morphological forms, including yeast cells, germ tubes, pseudohyphae, true hyphae, and chlamydospores, depending on environmental conditions. This organism demonstrates rapid morphological and physiological changes through phenotypic switching. Furthermore, *C. albicans* is capable of colonizing root canal walls, penetrating dentinal tubules, and utilizing dentin as a nutritional source [4].

The antimicrobial activity of tea extracts has been closely associated with their polyphenol content [8]. Differences in antimicrobial efficacy among various tea types are largely attributed to variations in polyphenol concentrations. To better simulate intraoral conditions, *C. albicans* is commonly cultured in biofilm form in in vitro studies. Green tea has consistently demonstrated antifungal activity against *C. albicans*, supporting its potential application in oral health management [32].

3.3. Antifungal and Antimicrobial Effects of Green Tea

The antibacterial and antifungal effects of green tea-based mouthwash formulations are consistent with previous studies. Rinsing with green tea extract has been shown to exert anticariogenic effects, including inhibition of bacterial adhesion to tooth surfaces. Green tea contains high levels of polyphenols, particularly flavonoids, with catechins as the predominant flavonoid component. In addition, green tea contains gallic acid and fluoride, which further contribute to its antimicrobial properties [14].

Previous studies have supported the inhibitory effects of green tea against *C. albicans*. Catechins present in green tea have also been reported to maintain salivary pH within the normal range, thereby creating unfavorable conditions for cariogenic bacterial growth [31]. In vitro studies have demonstrated that green tea polyphenols and catechins inhibited *C. albicans* growth by approximately 40% and 75%, respectively [10]. Moreover, green tea catechins have exhibited antimicrobial activity against a wide range of microorganisms, including multidrug-resistant Gram-positive and Gram-negative bacteria as well as yeasts [11].

Among several tea extracts evaluated, green tea was found to contain the highest total catechin concentration. Huang et al. (2020) reported that catechin levels are significantly influenced by both the concentration of the tea extract and the type of tea used [13].

3.4. Comparative Antifungal Potential of Bush Tea and Other Herbal Teas

Green tea polyphenols are considered safe and consist of active compounds that provide physiological benefits beyond antioxidant and anti-inflammatory effects. Additionally, green tea is readily available, cost-effective, has a long shelf life, exhibits low toxicity, and shows minimal potential for inducing antimicrobial resistance, making it a promising natural therapeutic alternative [20].

Bush tea has been reported to contain a total polyphenol concentration of approximately 6.41 mg/100 g, with tannin levels lower than the total polyphenol content. The minimum microbicidal concentration (MMC) of bush tea has been shown to be effective against *C. albicans* [32] In contrast, studies on Mongolian herbal tea—which consists of multiple medicinal plants such as *Rosa acicularis, Vaccinium vitis-idaea, Betula platyphylla, Taraxacum officinale,* and *Plantago major*—reported no inhibitory effect against *C. albicans* [33].

The absence of antifungal activity in Mongolian herbal tea may be attributed to the presence of glucose and ascorbic acid in its composition. Glucose is a known factor that promotes the growth and proliferation of *Candida* species in the oral cavity [16]. However, other studies have reported delayed *C. albicans* growth with increasing concentrations of ascorbic acid, indicating that antifungal effects may depend on compound concentration and formulation [19].

4. Conclusion

Based on the results of our study, it can be concluded that green tea and bush tea may serve as cost-effective alternatives to NaF mouthwash. Although Mongolian herbal tea contains polyphenols, the presence of glucose and ascorbic acid as its components may promote the growth of *Candida albicans* over time. Nevertheless, further studies are warranted to evaluate the potential side effects and long-term efficacy of herbal mouthwashes.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest.

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