



Propolis as an alternative in prevention and control of dental cavity

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ABSTRACT

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Propolis is a natural product, collected by bees from tree buds, flowers and pollen. It possesses various pharmaceutical properties, including antibacterial action against microorganisms involved in the beginning and progression of dental caries. This research aimed to analyze literature regarding propolis and its antimicrobial activity against microorganisms within dental biofilm, and evaluate the possibility of its employment as an adjunct to prevention and ultraconservative treatment of dental caries. Results confirmed propolis' great potential as a natural medicine with solid therapeutic properties and proven anti-cariogenic action.

KEY WORDS: Propolis; Dental cavity; Treatment; Prevention

INTRODUCTION

Dental caries is considered an universal health problem, recognized as a significant pathological entity in the history of mankind. Caries results from teeth's mineralized tissues dissolution under specific microorganisms action, which metabolize fermentable carbohydrates and produce acids. Constant acid action on teeth's surfaces originates a cavity, and its evolution, in extreme cases, can destroy the entire dental crown [1].

Bacterial plaque or biofilm is composed by bacterial deposits and food debris strongly attached to dental surfaces, it is colonized by multiple organisms present in the oral microbiota. As deposits become thicker, gradual oxygen reduction promotes a progressive exchange from aerobic bacteria to facultative and strictly anaerobic germs. After two weeks of undisturbed growth, dental plaque lodges innumerable bacterial species [2].

Frequent biofilm exposure to saccharose diminishes its pH, favoring aciduric and acidogenic bacteria, such as *Streptococcus mutans* and *Lactobacillus*, which are Gram-positive bacteria and produce organic acids, mainly lactic acid from glucose [3]. Among these microorganisms, *Streptococcus mutans* are considered the most cariogenic ones. They are associated to the beginning of caries lesions, while *lactobacilli* are associated to disease's progression [2].

Caries treatment underwent significant modifications over time, especially due to a greater knowledge on disease's mechanisms, allowing its prevention and stoppage, as well as due technological evolution of restorative materials, improving adhesiveness and promoting fluorine liberation [4,5].

Conventional caries lesions' restoration treatment is based on invasive surgical procedures in order to reestablish dental surface integrity and function [6].

Epidemiologic studies demonstrated that treating caries sequelae or caries lesions do not prevent its recurrence and do not effectively decrease its prevalence. Based on these findings, a new treatment philosophy affirms that precise diagnosis and effective control of mechanisms that originate dental caries can promote positive results [1].

Non-operative treatment aims to interrupt lesions activity, especially those situated on free and smooth dental surfaces, preserving surrounding hard tissues [7]. Minimally invasive ultraconservative conduct, based on biofilm mechanical and chemical disorganization, such as Fluoride [8] and antimicrobials [9] administration by professionals, is preferable to traditional treatment of initial lesions, due to its proven efficacy and maximum preservation of dental structure.

Transition from "healthy" to pathological oral biofilm is etiologically associated to dental diseases, e.g. caries, periodontitis or periimplantitis. Besides *Streptococcus mutans* and *lactobacilli*, there is approximately 700 bacterial species found in oral biofilm. Some of them are resistant to conventional antimicrobial therapies with antibacterial agents, such as antibiotics and chlorhexidine. For example, *Staphylococcus aureus* is resistant to methicillin, and enterococci are resistant to vancomycin. This resistance to antibiotics motivated new therapeutic discoveries, utilizing natural photochemicals in order to control dental biofilm and associated diseases, such as dental caries [10].

Propolis differs among natural products due to its pharmaceutical properties diversity. It is collected by bees from tree buds, flowers and pollen, and possesses bactericide, anti-inflammatory, antiviral, fungicide, antioxidant, bioestimulative and antitumor properties [11,13]. It has cytotoxic and healing activities on osseous and cartilaginous tissues, dental pulp, and others. It is also biocompatible with human tissues [14].

This research aimed to analyze literature regarding propolis and its antimicrobial activity against microorganisms present in dental biofilm, evaluating the possibility of its employment as an adjunct to prevention and ultraconservative treatment of dental caries. It was possible to conclude that propolis has great potential as a natural medicine with solid therapeutic properties and proven anti-cariogenic action.

PROPOLIS

Evidence of resistant pathogenic microorganisms selection due to prolonged and indiscriminate use of synthetic chemical antimicrobials, stimulated researches in order to discover, in nature, innovative drugs with therapeutic properties against diseases [15]. According to Silva et al. (2008) [16], importance of natural products can be proven by the fact that, between 1983 and 1994, 28% of all new drugs approved by the Food and Drug Administration (FDA) were originated from natural products.

Propolis is classified as an ophotherapeutic medicine due to its complex chemical composition of organic secretions from bees [17]. Its use for medical purposes was first recognized in ancient Greece and Rome. Nowadays, it is still used as treatment to multiple diseases due to its biological activities variability. Japanese population is acquainted with propolis extract products, and the country is the main Brazilian propolis importer [18,19].

This herbal medicine is non-toxic when correctly administered, it is collected by bees from a wide variety of plants and it is utilized to protect the hive against other insects and invasive microorganisms entrance and to prepare an antiseptic shelter to the queen [16,20]. Propolis is composed of resins and aromatic balsams (50%), wax (25% to 35%), essential oils (10%), grains of pollen (5%), phenolic compounds (flavonoids and phenolic acids), minerals (copper, manganese, iron, calcium, aluminum, silicon) and vitamins [21].

Propolis physical, chemical and biological properties are directly related to its chemical composition, which varies according to the region's vegetation, pollen collection season and collection technique, it also depend on the bee species which collected it [22,23]. As these factors are important to define propolis' therapeutic properties, they constitute the biggest challenge to its phytotherapeutic use. Coloration depends on the extraction location, varying from dark brown to red and greenish tonalities. Characteristic odor also vary from a sample to another [21].

Propolis' bacterial, antifungal and anti-inflammatory activities are attributed mainly to phenolic compounds. As a bacterial and antifungal agent, its action mechanism is probably based on inhibition of bacterial RNA-polymerases or directly on bacteria membrane or cellular wall, causing functional and structural damages. Anti-inflammatory activity is present due to inhibitive action of cyclooxygenase (COX), and also due to inhibition of prostaglandins synthesis and thymus gland activation, stimulating cellular immunity [19,20,24].

ANTIMICROBIAL ACTIVITY OF PROPOLIS ON DENTAL BIOFILM

Propolis has become a new therapeutic agent of interest due to its pharmacological properties. Regarding its antibacterial activity, innumerable researches are being developed to clarify its role to inhibit microorganisms growth in oral infections [25-27].

Evaluation of propolis' antimicrobial action in vivo of natural products extracts, like aloe vera and propolis used on infected dentine, suggested its antibacterial activity, and its indication as a potential cavities disinfection agent after carious dentine removal, acting as an adjunct to minimal intervention techniques in odontology [28]. A similar study, concluded that propolis is as efficient as the chlorhexidine 2% and laser used to disinfect cavities [29].

Drumond et al. (2006) [30], compared the effect of a daily mouth wash utilizing a hidroalcoholic extract of propolis 6,25% on dental biofilm, gingival disease and *S. mutans* present in the saliva of 15 children. Results concluded that propolis solution was effective to decrease *Streptococcus mutans* levels in the oral cavity, proving daily mouth washes with propolis' effectiveness. These results are supported by Anauete Netto et al. (2013) [31], their study investigated antibacterial activity in vivo of a mouthrinse containing propolis at 2% on *Streptococcus mutans* compared to chlorhexidine 0.12%, and concluded that, in the period between 14 to 28 days, propolis was superior in suppressing *Streptococcus mutans* levels, and that its residual effects were present after 45 days.

Akca et al. (2016) [32] and Fernandes Júnior et al. (2001) [20] evaluated propolis' antibacterial activity and its effectiveness against gram-positive microorganisms. Vargas et al. (2004) [15] isolated samples of *Nocardia*, and tests revealed that 100% of sample demonstrated sensibility to the extract, in addition, 97.83% of *Staphylococcus sp.* were also sensitized, 80-95% of *Streptococcus sp.*, and 80% of *Rhodococcus equi* suffered growth inhibition. In a similar study, Suleman et al. (2015) [33] confirmed antibacterial activities of ethanolic propolis extracts against *Streptococcus aureus* and *Enterococcus faecalis*.

Gram-positive bacteria sensibility to propolis extracts is mentioned in several studies [15,20,33-35]. However, its

diminished activity against gram-negative microorganisms is still unknown. It might occur due to the fact that cellular wall of gram-negative bacteria is more complex and has higher lipid concentration [19].

Vasconcellos et al. (2014) [36] tested two varieties of Brazilian propolis (green and red) incorporated to bioactive glasses against oral pathogens. They concluded that this formulation (bio glass) can be used as an alternative therapy against infectious agents in oral cavity. The new formulation of propolis was effective to control microorganisms proliferation (*Streptococcus mutans*, *Staphylococcus aureus*, *Enterococcus faecalis*), and red Brazilian propolis was more active than green propolis.

Propolis was also effective against *Lactobacillus* [32,37,38], a bacteria associated to dental caries progression, as they are unable to adhere to dental surfaces, thus, it is present when caries cavities are able to retain and shelter them [2], restraining their removal through saliva flow. These studies confirm propolis' success as cavity disinfection agent and adjunct to conservative techniques, such as expectant treatment and atraumatic restorative treatment (ART) [39].

Commercially, propolis is usually incorporated to various pharmaceutical applications, for example, hydroalcoholic solutions, gels, creams, soaps [40], and formulations successfully investigated by researchers against oral pathogens. Franca Jr. et al. (2014) [41] and De Lucca et al. (2014) [42] tested a non-toxic chitosan varnish with high adherence and antimicrobial activity, that allows its contact with dental tissues for longer periods of time; Tussani et al (2014) [43] developed chewing gum, a more attractive product for children; Mohsin et al (2015) [29] and Vanni et al (2015) [44] developed a dental cream with proven antibacterial activity against *S. mutans* and linear biofilm reduction capacity of 80-88%, respectively; hydroalcoholic formulations and gels are also accepted and employed as vehicle to propolis extracts in several scientific researches [25,26,29,37,38]. Formulations developed are considered efficient and adequate for dental caries prevention, as they allow propolis administration and can be easily disseminated in dental clinics and public locations.

Dental caries is a multifactorial disease, one of its main etiologic agents are *Streptococcus mutans*. Thus, natural products, such as propolis, are an important and valuable alternative to caries treatment, acting on dental biofilm formation [45-50], when professional's intervention is more effective.

CONCLUSION

Based on literature review, it is possible to conclude that propolis is a promising natural medicine with defined therapeutic properties and confirmed anticariogenic action. Other studies are necessary in order to chemically standardize it, and to determine the most effective and safest concentration, thus, propolis extracts can be employed in large scale for dental caries prevention.

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