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Potential Use of Propolis as Endodontic Irrigant

Claudemir De Carvalho[1], Elizandra Mara De Lima[2], Ana Paula Dos Santos Moraes[2], Kele Pereira Da Silva[2]

[1]*Dean of Research and Graduate Studies, University Center FUNVIC, Pindamonhangaba-SP, Brazil.*
[2]*Dentistry student, University Center FUNVIC, Pindamonhangaba-SP, Pindamonhangaba-SP, Brazil.*
**Corresponding author: Claudemir De Carvalho.*

Abstract

Objective of this work was to review the use of propolis as an endodontic irrigant. For this, keywords were searched in the PubMed database, from April to October 2022. There are many chemical compounds in propolis from different geographic regions; Flavonoids are one of the most important agents that have anti-inflammatory, anti-viral, anti-allergic, anti-cancer, anti-bacterial and antioxidant effects. According to the mentioned properties, propolis can be used as a canal irrigation solution, as well as intracanal medicine in endodontic treatments. The results described in the literature are practically unanimous in showing the antibacterial and antifungal effects of different propolis extracts at different concentrations. In addition to flavonoids, other components of propolis such as resin, pollen, vitamins and phenols, indicate that propolis can be used not only as an intracanal irrigation solution, but for various purposes, with a promising role in endodontics as well as dentistry.

Keywords: propolis and endodontics; propolis and endodontic irrigants; propolis and root canal irrigant; propolis as intracanal medicament

Introduction

In endodontics, the objective of biomechanical preparation is to perform cleaning and disinfection of the root canal system (RCS) [1]. The presence of microorganisms in the root canal system is the main cause of endodontic infections and their viability depends on the redox potential, the availability of nutrients and the host's defense system. The identification of the predominant microorganisms in the infections makes it possible to adopt measures aimed at their elimination inside the canal. It is known that instrumentation, alone, does not guarantee the complete removal or inactivation of pathogens in infected canals, irrigation and medication are important, associating mechanical cleaning with the use of antibacterial agents, to improve the effectiveness of the treatment [2]. Irrigating solutions are used in endodontic treatment in order to eliminate bacteria from root canals. Several studies have been carried out in the search for irrigants that combine better properties, including antimicrobial activity, low or no toxicity to periapical tissues, solubility and ability to dissolve organic matter [3,4]. Intracanal medications are used as adjuvants in endodontic treatment, with the aim of moderating pain, reducing remaining bacteria and their metabolites, and accelerating the healing process [5]. In this context, propolis appears as an alternative of interest to complement treatment. Propolis is a resinous complex produced by the bees Apis mellifera L. whose variety of pharmacological properties results from the complexity of its composition [6,7,8]. It is composed of resin and balms (50-60%), pollen (5-10%), and other constituents such as amino acids, minerals, vitamins A and B complex, flavonoids, phenols, and aromatic compounds [9]. In general, propolis has been used as an anesthetic, anti-inflammatory, antibacterial, antiviral, antifungal, antioxidant, anticancer, antidiabetes, immunomodulator, tumoricide, among others. In dentistry, propolis has been used experimentally in the areas of endodontics, cariology, oral surgery, periodontics and oral pathology, among others [1,10]. Propolis extracts are commonly obtained from continuous immersion in various solvents, but there are other methods, including ultrasound and microwaves [11]. Because it is natural, non-toxic, low cost, does not cause microbial resistance and has a variety of therapeutic activities, propolis It is a product with good prospects for use in the dental field, including expansion of its field of applicability. There is evidence that it can be used as an alternative in the

control and prevention of oral diseases. The results found in the literature are promising, so research involving propolis has been increasing both in quantity and complexity [12,13]. The present study aimed to review the literature about the potential use of propolis as an endodontic irrigant.

Methodology

From April to October 2022, a bibliographic search was carried out to locate articles published on the use of propolis as an endodontic irrigant. An electronic search was performed in the PubMed database using the following combinations of keywords: propolis and endodontics (124), propolis and endodontic irrigants (38), propolis and root canal irrigant (47) and propolis as intracanal medicament (32). Articles were included in full, published in English from the year 2000 onwards, describing in vitro or in vivo experiments showing the use of propolis as an intracanal irrigant.

Results

Among the 241 articles obtained, only specific full-length articles in English were used. Duplicate, non-specific articles that did not mention the pharmaceutical form and/or concentration of propolis used were excluded. Finally, 24 articles were included in the present study (Table 1).

Table 1: Number and characteristics of selected articles.

Number of articles	Type of search	Pharmaceutical form / Concentration used	Conclusion
24	Experimental in vitro 20 Experimental in vivo 03 Meta-analysis–01	Propolis extracts were used at different concentrations	It was possible to verify the effectiveness of propolis extracts used as irrigants due to their antibacterial and antifungal action. Propolis is more reliable in terms of toxicity.

The information contained in the selected articles is summarized in Table 2.
RMGIC Resin-modified glass ionomer cements; HDPF Human dental pulp fibroblast.
Table 2: Potential use of propolis as an endodontic irrigant, according to the literature.

Reference	Type of Search	Pharmaceutical Form / Concentration Used	Conclusion
Geraldini, et al. [14] 2000	Experimental in vitro (teeth)	Propolis Ethanol Extract (PEE) 10%, 20% and 30%	The three concentrations were efficient for removing smear, promoting cleaning of the dental canal.
Al-Qathami e Al-Madi [15] 2003	Experimental in vitro (teeth)	Propolis solution 1:120 (500 mg of propolis dissolved in 120 mL of destilled water)	Propolis extract significantly reduced contamination of dental canals
Oncag et al. [16] 2006	Experimental in vitro (teeth)	Aqueous extract of propolis (Does not mention the concentration)	Propolis had good in vitro activity against E. faecalis in dental canals
Ferreira et al. [17] 2007	Experimental in vitro	Propolis Ethanol Extract (PEE) 10%	PEE proved to be effective against *Prevotella nigrescens*, *Fusobacterium nucleatum*, *Actinomyces israelii*, *Clostridium perfringens*, *Enterococcus faecalis*
Maia Filho et al. [3] 2008	Experimental in vitro (teeth)	Propolis extract (1g/mL) in dilutions1:10, 1:20, 1:40, 1:80 e 1:160.	Propolis extract at a 1:10 dilution (1mg/mL) showed good antimicrobial activity against *E. faecalis*, being greater than 5% sodium hypochlorite and less than chlorhexidine gel
Rezende et al. [18] 2008	Experimental in vivo	Propolis Ethanol Extract (PEE) 11% Aqueous extract of propolis 11%	The two extracts showed a zone of inhibition against microorganisms isolated from the root canal of the teeth.
Awawdeh et al. [19] 2009	Experimental in vitro (teeth)	Propolis extract (does not mention the concentration)	Propolis was more effective as an intracanal treatment in eliminating *E. faecalis*
Kandaswamy et al. [20] 2010	Experimental in vitro (teeth)	Green propolis extract in various concentrations	Propolis had good antibacterial activity against *E. fecalis*
Carbajal Mejía [21] 2013	Experimental in vitro (teeth)	Peruvian propolis extract (does not mention the concentration)	Propolis showed the same efficiency as 2% chorexedin for the control of *E. fecalis* and *C. albicans* in artificially contaminated dentinal canals
Jolly et al. [22] 2013	Experimental in vivo	Propolis dimethyl sulfoxide extract (DMSO)	Propolis showed a marked decrease in colony-forming units of aerobic and anaerobic endodontic bacteria.
Tiagy et al. [23] 2013	Experimental in vitro (teeth)	Green propolis ethanol extract 11%	Propolis had a marked antimicrobial action against *C. albicans*
Maekawa et al. [24] 2013	Experimental in vitro (teeth)	Propolis glycolic extract 12%	The extract used was eficiente against *C. albicans*, *E. faecalis* e *E. coli* in root canals
Ehsani et al. [25] 2013	Experimental in vitro (diffusion test)	Propolis Ethanol Extract (PEE) 15% e 40%; Aqueous extract of própolis	The aqueous extract was not effective, but the 15% and 40% extracts were effective against *E. faecalis*.
Siqueira et al. [2] 2014	Experimental in vitro (diffusion test)	Red propolis extract 1%; 2,5%; 5% e 7,5%	The 7.5% solution was more effective against *E. faecalis* when compared to the others
Verma et al. [26] 2014	Experimental in vivo	Aqueous extract of própolis 25%	The authors confirmed the antibacterial efficacy of water-soluble propolis extract in the root canals of deciduous teeth in vivo.
Lopez et al. [27] 2015	Experimental in vitro (diffusion and cytotoxicity tests)	Red propolis extract in various concentrations	All concentrations were effective against Gram positive and Gram-negative bacteria and different species of *Candida*. Low toxicity to human keratinocytes and murine fibroblasts
Agrawal et al. [28] 2016	Meta-analysis	Green propolis extract in various concentrations	The different concentrations used by various authors showed antibacterial and antifungal action
Silva et al. [4] 2016	Experimental in vitro (diffusion test)	Aqueous extract of própolis (Does not mention the concentration)	Propolis showed antibacterial action against *E. fecalis*, however, less than 2.5% sodium hypochlorite and 2% chlorhexidine
Jaiswal et al. [29] 2017	Experimental in vitro (teeth)	Aqueous extract of própolis 0,2%	Propolis proved to be as effective as 5% sodium hypochlorite against *E. fecalis*
Uğur Aydin et al. [30] 2018	Experimental in vitro (cytotoxicity test)	Propolis ethanol extract (PEE) 15%	Propolis proved to be more reliable, in terms of toxicity, than the gold standard irrigant sodium hypochlorite
Matochek et al. [31] 2020	Experimental in vitro (teeth)	Aqueous solution of ethanolic extract of propolis	The propolis-based aqueous solution was less aggressive for dentin root surfaces, not interfering with the adhesion of resin cements
Almadi et al. [32] 2020	Experimental in vitro (teeth)	Propolis ethanol extract (PEE) density of 160mg/mL	Propolis can be used as a potential irrigant for canal disinfectant as long as the composition becomes standardized
Parolia et al. [33] 2021	Experimental in vitro (teeth)	Nanoparticles of propolis (NPs)	NP300 was significantly more effective in reducing E faecalis. Electronic myroscopy images also showed greater effectiveness of NP300 in reducing *E. faecalis*.
Oliveira Neto et al. [34] 2022	Experimental in vitro (Toxicity against endodontic pathogens and cytotoxicity)	Red propolis raw extract (RPRE) 10µg/mL and 50µg/mL	RPRE exhibited good antibacterial activity against endodontic pathogens and promoted the viability of HDPF

Discussion

Irrigation of the root canal system must be carried out simultaneously with instrumentation for the correct elimination of microorganisms through the antimicrobial action of the applied substances. These substances must have a potent antimicrobial action to combat the microbiota present in endodontic infections [1,3,5]. The antimicrobial action of propolis in relation to the oral microbiota has been demonstrated over the years [13,17,21,28,34]. Until the late 1990s and early 2000s, formocresol and its like were often used as intracanal drugs, but such chemicals used as bactericides have been shown to diffuse throughout the body from the root apex, resulting in cases of undesirable effects, including allergies. Furthermore, as these drugs are potent carcinogens, there is no indication for these chemicals in modern endodontic treatment. Today, biocompatibility and stability are essential properties for intracanal drugs.36 Propolis has been demonstrated as a bioactive, biocompatible and non-toxic product [27,30].

The gold standard irrigant is sodium hypochlorite solution (NaOCl), normally 2.5%, due to its strong antimicrobial action and its dissolution of organic tissue. Its effectiveness is proportional to the concentration used, however, the higher it is, the greater the toxic effect on the periapical tissues and the more serious the complications arising from contact with the periradicular tissues [37]. Noites et al. [38] and Borrin et al. [39] report the complications that may arise during the use of sodium hypochlorite in endodontic treatment. Depending on the concentration of the solution used, bruising, pain, damage to vital tissues such as ulceration, necrosis, inhibition of neutrophil migration, damage to endothelial and fibroblastic cells may occur. Teixeira et al. [40] and Böhle et al. [41] also reported toxic effects of 2.5% NaCl solution for fibroblasts. No reports of propolis-based irrigating solution toxicity were found. Dentistry has been carrying out several studies regarding natural products that have pharmacological activity, reduced toxicity and biocompatibility, so that they are more accessible to the population. The usual indications for these products are associated with the treatment of infections, inflammation, toothache, scarring processes, maintaining good oral health through natural products [42]. Propolis, being a natural product, of plant origin and non-toxic, does not cause tissue damage and has a wide range of therapeutic properties, allowing its use in toothpastes, rinses, varnishes and irrigants, being a good natural product for the therapy of the oral microbiota [1,42]. Propolis is a powerful natural product, resulting from the combination of numerous chemical assets such as fatty acids, alcohols, amino acids, vitamins and mineral salts, with flavonoids being the main components. Propolis is an efficient alternative for the treatment and prevention of several oral problems such as dental caries, mucositis and endodontic treatment, due to its therapeutic diversity, its low toxicity, low cost and proven applicability [43,44]. According to Pinto et al. [12], propolis has low innate toxicity because flavonoids, its main constituents, have very low toxicity. The chemical composition of propolis is very complex and its content varies greatly depending on location, climate, year and season [6]. Despite the popularity of propolis over time, it is not considered a conventional therapeutic agent due to restrictions to regulate chemical composition and biological activity [45]. This standardization is indispensable for acceptance in the health system. Under these circumstances, the characterization of different types of propolis, according to their plant origin and chemical profile, becomes necessary [46]. Prospective studies in intellectual property databases are important to increase market competitiveness and thus generate new products in different areas of research [8].

Conclusion

Propolis and its phenolic and flavonoid constituents have many therapeutic uses in dentistry and oral health. Wide therapeutic uses due to its antibacterial, antiviral, antifungal, anti-inflammatory and anticancer properties have been demonstrated in several in vitro and in vivo studies, as well as in human clinical trials. As intracanal irrigants, the different extracts used, in different concentrations, proved to be effective against some of the main intracanal contaminants. However, there is a great need to standardize the content of phenolics and flavonoids in propolis to obtain the best therapeutic benefits in dentistry and oral health.

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