Properties and uses of propolis in dentistry: a review

Propiedades y usos del propóleo en odontología: una revisión

Propriedades e usos da própolis na odontologia: uma revisão

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Abstract

Propolis is a dark-colored sticky material obtained from various plants and mixed with wax, derived from bees who use it to protect their hives. The aim of the present work was to carry out a literature review on the properties and uses of propolis in dentistry. A bibliographic search of reports published from March 2010 to March 2020 was performed in PubMed, Imbiomed, Medigraphic, SciELO and Google Scholar using the words: propolis, properties, uses. Thirty-nine articles were selected for review. The main properties reported were: antimicrobial, anti-inflammatory, immunomodulatory, and wound healing. The main reported uses covered the following areas of dentistry: caries prevention, endodontics, periodontics, prosthodontics and surgery. In recent years, special attention has been given to the applications of propolis as its efficacy has been demonstrated in different areas of dentistry.

Keywords: propolis, properties, uses, dentistry.

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Resumen

El propóleo es un material pegajoso de color oscuro obtenido de diversas plantas y mezclado con cera, deriva de las abejas quienes lo utilizan para proteger las colmenas. El objetivo del presente trabajo fue realizar una revisión bibliográfica acerca de las propiedades y usos del propóleo en odontología. Se realizó una búsqueda bibliográfica de reportes publicados de marzo del 2010 a marzo del 2020 en PubMed, Imbiomed, Medigraphic, SciELO y Google Scholar usando las palabras: propóleo, propiedades, usos. Se seleccionaron 39 artículos para la revisión. Las principales propiedades reportadas fueron: antimicrobiana, antiinflamatoria, inmunomodulador y cicatrizante. Los principales usos reportados abarcaron las siguientes áreas de la odontología: prevención de caries, endodoncia, periodoncia, prostodoncia y cirugía. En los últimos años, se ha puesto especial atención a las aplicaciones del propóleo ya que se ha demostrado su eficacia en distintas áreas de la odontología.

Palabras clave: propóleo, propiedades, usos, odontología.

Resumo

A Própolis é um material pegajoso de cor escura obtido de várias plantas e misturado com cera, derivado de abelhas que o utilizam para proteger suas colmeias. O objetivo deste estudo foi realizar uma revisão bibliográfica sobre as propriedades e usos da própolis na odontologia. Uma pesquisa bibliográfica de relatórios publicados de março de 2010 a março de 2020 foi realizada na PubMed, Imbiomed, Medigraphic, SciELO e Google Scholar usando as palavras: própolis, propriedades, usos. Trinta e nove artigos foram selecionados para revisão. As principais propriedades relatadas foram: antimicrobiano, anti-inflamatório, imunomodulador e cicatrização de feridas. Os principais usos relatados cobriram as seguintes áreas da odontologia: prevenção de cárie, endodontia, periodontia, prótese dentária e cirurgia. Nos últimos anos, uma atenção especial tem sido dada às aplicações do própolis, pois sua eficácia tem sido demonstrada em diferentes áreas da odontologia.

Palavras-chave: própolis, propriedades, usos, odontologia.

Introduction

Dentistry is an area of health sciences that deals with studying, diagnosing, treating, and preventing diseases affecting the stomatognathic system formed by the teeth, oral cavity, jaws, muscles, tissues (skin and skin and mucous membranes), vessels, and nerves. The most common dental conditions are caries and periodontal diseases. The pain, inflammation, and infection associated with these pathologies have been studied and treated by stomatologists throughout the history of humankind.[1,2]

Honey and propolis have been known since ancient times and have been widely used by different cultures to treat dental pathologies.[3] Research has shown that propolis has antibacterial, antifungal, and antiinflammatory effects, among others.[4] This substance is a natural and inexpensive product, so everyone can afford it.[5] However, there is little evidence on the use of propolis to treat oral conditions.[6,7] Information about propolis in various dental disciplines is scarce. Therefore, this work aims to conduct a literature review of the properties and uses of propolis in dentistry.

Methodology

A digital search was conducted in PubMed, Imbiomed, Medigraphic, SciELO, and Google Scho-

lar between 2010 and 2020 in English and Spanish. The keywords used were "propolis," "properties," "uses," and "dentistry," in addition to Boolean operators "AND" and "OR." Our search strategies combined keywords and Booleans as follows: "propolis," AND "properties" AND "dentistry," "propolis," AND "uses" AND "dentistry," "propolis," AND "dentistry," AND "properties" OR "uses." Database filters were used as follows: PubMed: free full text, clinical trial, controlled trial, systematic review, human, dental journals; Medigraphic: dental specialties. Imbiomed: dental journals, stomatological specialties, dentistry, different countries; ScieLo: all countries, dental journals, area (health sciences), subject area (oral, pharmacology, dental), type of literature (articles).

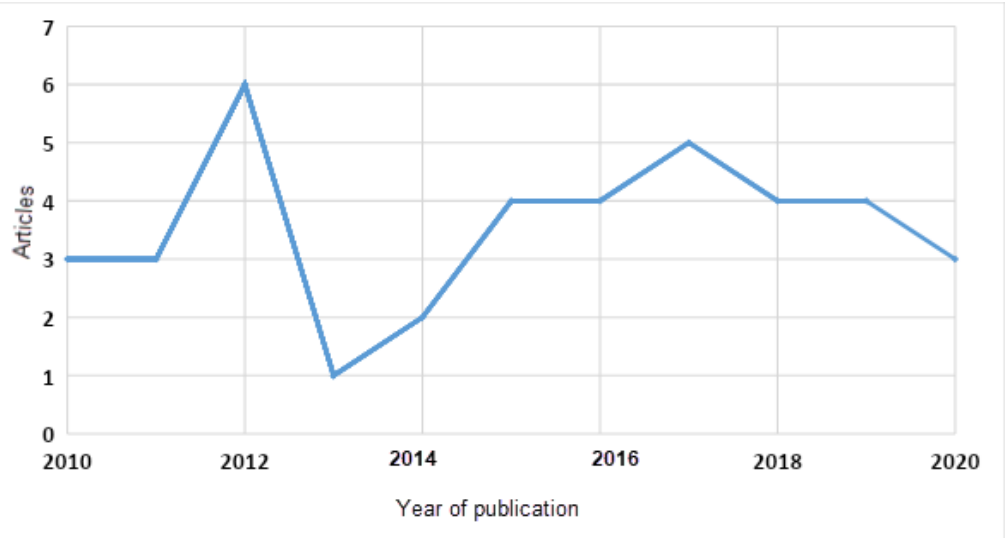
Inclusion criteria: a) articles published between 2010 and 2020 and b) articles in English and Spanish. Exclusion criteria: a) articles from studies using drugs, b) articles that studied propolis in an area other than dentistry, and c) articles with irrelevant content.

Results

The search yielded 67 articles, of which 28 were excluded. The remaining 39 articles were selected and analyzed.

Figure 1 shows the number of articles selected by year of publication. The articles included in this review were published yearly from 2010 to 2020; 2012 had the highest number of articles.

Figure 1: Number of articles by year of publication



Fifteen of the articles deal with using propolis to treat dental caries, seven refer to its application in endodontics, three to its uses in periodontics, one to periodontics and dental caries, five to oral surgery, two to prosthodontics, and six refer to the application of propolis in different areas (dental caries, endodontics, periodontics, prosthodontics, and oral surgery). Tables 1 to 5 present the articles grouped according to the dental area covered.

Table 1: Articles related to dental caries

Reference	Journal	Design
Pomilio et al. 2012[7]	Acta Bioquím Clín Latinoam	SR
Kuropatnicki et al. 2013[18]	Evidence Based Alternative Med	SR
Wagh et al. 2014[14]	Adv Pharmacol Sci	SR
Vanni et at. 2015[32]	Oral Health Prev Dent	SR
Ahmed-Daffalla et al. 2016[36]	J Int Oral Health	CE
Navarro-López et al. 2016[16]	RAAO	SR
Eralp-Akca et al. 2016[21]	Biomed Res Int	CE
Fernández-Montero et al. 2016[30]	Odont Vital	EPT
Santiago et al. 2018[22]	Nat Prod Res	RCTs
Airen et al. 2018[3]	J Indian Soc Pedod Prev Dent	SR
Liberio et al. 2019[6]	J Ethnopharmacol	CE
Nazeri et al. 2019[20]	Front Dent	CE
Leonel-Martins et al. 2019[33]	Arch Oral Biol	E in vitro
Cayo-Rojas et al. 2020[4]	Rev Cub Estomatol	SR
Halboub et al. 2020[23]	BMC Oral Health	E in vitro

SR=Systematic Review, CE=Controlled Experiment, EPT=Experimental Prospective Transactional, RCT=Randomized Controlled Trial, E=Experimental.

Table 2: Articles related to endodontics

Reference	Journal	Design
Kayaoglu et al. 2011[25]	J of Endod	CE
Madhana-Madhubala et al. 2011[27]	J of Endod	CE
Vieira-Ozorio et al. 2012[26]	J Dent Child	CE
Shrivastava et al. 2015[28]	J Contemp Dent Pract	E in vitro
Bustamante et al. 2017[5]	Acta Bioclínica	SR
Skoskiewicz-Malinowska et al. 2017[29]	Mini Rev Med Chem	SR
Shabbir et al. 2020[24]	Int J Environ Res Public Health	CE

CS=Comparative Study, CE=Controlled Experiment, E=Experimental, SR=Systematic Review, CCT=Controlled Clinical Trial.

Table 3: Articles related to oral surgery

Reference	Journal	Design
Gómez-Estrada et al. 2011[17]	BLACPMA	E in vitro
Suarez-Quinodoz et al. 2012[8]	Rev Fac Odontol	E in vitro
Bravo-Venero et al. 2012[35]	Rev Cub Farm	C and C
Lopes-Rocha et al. 2012[37]	Wound Healing Southern Africa	CE
Ishtiaq-Anjum et al. 2019[12]	Saudi J Biol Sci	SR

E=Experimental, C and C= Cases and Controls, CE=Controlled Experiment, RS=Systematic Review.

Table 4: Articles related to periodontics and prosthodontics

Reference	Specialty	Journal	Design
Herrera et al. 2010[38]	Prosthodontics	Cien Inv Agr	E in vitro
Al-Fahdawi et al. 2015 [19]	Prosthodontics	JDODT	SR
Ercan et al. 2015[34]	Prosthodontics	Eur J Dent	RCTs
Angulo et al. 2017[2]	Prosthodontics	Rev Venez Invest Odont	SR
Salazar-Caicedo et al. 2017[31]	Prosthodontics	Dom Cien	ODC

E=Experimental, RS=Systematic Review, RCT=Randomized clinical trial, ODC=Observational, descriptive, and comparative.

Table 5. Articles related to various dental specialties.*

Reference	Journal	Design
Premoli et al.2010[9]	Acta Odontol Venez	SR
Parolia et al. 2010[11]	Int J Med Med Sci	SR
Mayta-Tovalino et al.2012[13]	Rev Estomatol Herediana	SR
Felitti et al. 2014[1]	Actas Odontológicas	SR
Khurshid et al.2017[10]	J Dent Res Dent Clin Dent Prospects	SR
Amir et al.2018[15]	Ethiop J Health Sci	SR
De Carvalho-Furtado et al. 2018[39]	Recent Pat Biotechnol	SR

RS=Systematic Review. *The specialties covered in these articles are endodontics, periodontics, dental caries, and oral surgery.

Chemical composition

The chemical composition of propolis depends on the flora of the region where it is collected. Therefore, finding two hives that produce identical propolis is difficult even in the same geographical area. The bees produce it according to their needs and the raw material available.[8-10] However, all known propolis has qualitative and qualitative constant substances that are always present.[10-12]

Over 160 compounds have been identified in propolis, 50-55% of them phenolics (chemical compounds, antioxidants that help prevent some diseases) and flavonoids, in charge of the

pharmacological action of propolis. The wax and mechanical mixtures in propolis have no proven therapeutic activity and usually make up 30 to 45% of the total mass in a sample.[10,11]

Biological properties

The flavonoids and phenolic compounds in propolis have been reported to be responsible for propolis' biological effects and pharmacological action. Propolis has antimicrobial, anti-inflammatory, and immunomodulatory properties.[12-14] In this sense, flavonoids are the active principle of propolis and play a major role since they have the specific capacity to activate cytotoxic T lymphocytes (CTL) and natural killer (NK) cells, Several studies[15,16] suggest that this effect occurs due to the inhibition of cyclooxygenase (COX), which is the crucial enzyme in the synthesis of prostaglandins arachidonic acid oxidation. Prostaglandins perform various functions related to homeostasis, pain, inflammation, and neoplasm development. The flavonoids in propolis participate indirectly in the cellular immunity mechanism because they stimulate T8 lymphocytes. These receive the message from macrophages producing cytokines and interleukins, and other cells, which flag the presence of antigens in the body. T8 lymphocytes act as a second line of defense of the immune system. They act against invading cells, such as cancer cells, viruses, and bacterial cells.[16] Furthermore, propolis shortens the evolution of diseases with inflammatory processes.[17] Its immunomodulatory action has been associated with antitumor activity due to the activation of macrophages, which can lead to factors that interfere with the tumor cell or the functions of other immune cells.[18,19]

Uses in dentistry

After reviewing the selected articles, we confirmed that the use of propolis covers various dental conditions and procedures, which are described below.

Regarding prevention, propolis has anticariogenic properties. Studies show a reduction in caries incidence and dental plaque accumulation in vitro and in vivo. The antimicrobial effectiveness of the extracts depends on the solvent used, the origin of the propolis, and the microbial species evaluated. The most effective ones are the ethanolic extracts (EEP), such as apigenin (flavonoid) and t-farnesol (terpenoid). They have shown the greatest antimicrobial properties against Streptococcus mutans, based mainly on their ability to inhibit glycosyltransferases and their bactericidal effect.[3-7] Other authors have shown that fatty acids in propolis provide a cariostatic effect by decreasing fatty acid production.[10] Clinical studies have been conducted with lab rats comparing three substances. First, a propolis mouthwash with water, and second, a chlorhexidine (CHX) mouthwash. And, finally, Listerine®. Propolis was the most effective substance against the following bacteria: Staphylococcus aureus (S.aureus), Streptococcus mutans (S.mutans), Lactobacillus acidophilus (L.acidophilus), and Enterococcus faecalis (E. faecalis).[21–24]

Regarding endodontics, the biocompatibility and antimicrobial properties of propolis have been demonstrated in comparison with calcium hydroxide as an intracanal medication in endodontic treatment.[25-27] In addition, studies have compared and assessed the antimicrobial action of calcium hydroxide, triantibiotic mixture (TAM), and an ethanol extract of propolis as intracanal medications in root canals infected with Enterococcus faecalis (microorganism that appears in most endodontic complications). They concluded that propolis was more effective than TAM against E. faecalis over two days, and at seven days; both were equally effective and reduced healing time.[28] Propolis and calcium hydroxide synergize with moxifloxacin and ciprofloxacin against E. faecalis. [29,30] Propolis has also been compared to sodium hypochlorite and found to be equally effective. It has the advantage that propolis protects periodontal cells against periapical inflammation.

As for periodontics, propolis has proven to be a

good healing agent in chronic gingivitis and recurrent and non-specific mouth ulcers. It acts at the supragingival plaque level (against Gram +) helping tissue recovery, inhibits prostaglandin synthesis, and helps the immune system by promoting phagocytosis and stimulating cellular immunity.[1,9,32] SalazarCaicedo et al. conducted a study applying 0.12% propolis tincture after basic periodontal therapy and periodontal plastic surgery on a patient with periodontal disease, gingival enlargement, and high frenulum insertion. Cotton swabs soaked in propolis tincture were administered after basic periodontal therapy. The procedure was repeated 24 and 48 hours after the treatment. Propolis worked as an excellent healing agent on the gingival tissue, reducing evolution by improving hemostasis and tissue-healing time.[31] Studies with propolis paste and mouthwash showed inhibition of supragingival biofilm growth, with a linear reduction of approximately 80-88%.[32–35]

As for oral surgery, propolis has been used in wounds (alveoli) after tooth extractions in the form of 5% propolis tincture. This led to symptom remission and a shorter evolution time.[36,37] Herrera et al. (2010) determined the effects of topical administration of propolis and dexamethasone on oral surgical wounds in laboratory hamsters. The wounds were treated with topical applications of a 30% ethanolic extract of propolis (EEP), 0.1% dexamethasone in orabase gel, and orabase gel alone. They found that EEP had a greater anti-inflammatory effect and reduced wound-healing time than dexamethasone in orabase gel.[38]

Oral candidiasis is an infection of the oral cavity mucosa caused by yeasts of the Candida genus in populations that use removable dentures. In prosthodontics, propolis-based products have significant antifungal properties, especially on Candida albicans, so once again, propolis can be of great use in prosthodontics.[38,39]

Conclusions

The articles analyzed in this review show that the biological principles of propolis entail multiple pharmacological properties, including antimicrobial, anti-inflammatory, immunomodulatory, anticariogenic, and healing effects. Therefore, this compound should be considered as a valid option in dentistry. In addition, propolis has been attributed relevant characteristics such as rapid post-surgical healing and inhibition of dental plaque formation.

Propolis is perfectly compatible, and although its applications have progressed significantly, its growth in the field of dental products is slow. Therefore, the therapeutic properties of this compound could be essential in the development of innovative dental products.

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