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Effect of Propolis in Oral Health

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ABSTRACT

Propolis is a natural product derived from plant resins collected by honey bees. It is used by bees as glue, a general-purpose sealer and as draught-extruder for bee hives. Propolis has been used in folk medicine for centuries. The main chemical classes present in propolis are flavonoids, phenolics and other various aromatic compounds. Flavonoids are well known plant compounds that have antibacterial, antifungal, antiviral, antioxidant and anti-inflammatory proprieties. Propolis has been used in dentistry for various purposes and has a promising role in future medicine as well as in dentistry. Its natural resinous substance shows dental application based on its antimicrobial, anti-inflammatory and immunomodulating effects. Propolis is used in dentistry as active ingredient as mouth rinse for plaque control, treatment of various oral lesions, intracanal medicaments, storage media for avulsed teeth, wound healing. This paper gives an overview of propolis, its ingredients, properties and various therapeutic and dental applications.

Key words: Propolis, mouth rinse, wound healing, intracanal medicament.

INTRODUCTION

The word Propolis originates from Greek: pro - in front, polis - city. Propolis is also known as bee glue.[1] It helps in cementing the openings of the bee hive. Propolis is a resinous mixture collected from trees by the Apis mellifera bee, which uses as a building insulating material in the beehive as well as for keeping it in good health (Greenaway et al., 1990).[2] It has important pharmacological properties and it can be used for a wide range of purposes as anti-inflammatory, hypotensive agent, immune system stimulant, bacteriostatic and bactericidal agent (Ghisalberti,1979).[3] All such applications have increased its pharmaceutical demand and have rendered it an interesting subject of study. In Argentina, the INAL (The National Food Institute) recognized Propolis as a diet supplement in 1995 (file 2110-003755-4 in the Argentine Food Code) (Gonzalez et al., 2003).[4] Propolis has been used for treating different diseases and inflammatory conditions as both local and systemic applications.

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Properties of Propolis

It is naturally available as sticky form in room temperature but becomes hard and brittle at low temperature. Propolis cannot be used raw due to its complex nature. Lipophilic property of Propolis makes possible for it to be dissolved in various solvents.[5],[6]

Composition of Propolis

Ingredients	Percentage
Resin and balsams	50 - 70%
Essential oils and wax	30 - 50%
Pollen	5 – 10%
Amino acids, minerals,	1 – 2%

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vitamins	
Biochemical substances (bioflavenoid)	0.7%
Phenols and aromatic compounds	0.4%

Flavonoids are well known plant compounds which have antibacterial, antifungal, antiviral, antioxidant and anti-inflammatory proprieties. Propolis has been found to be very effective against Gram positive bacteria (Seidel et al., 2008) especially, Staphylococcus aureus (Velazquez et al., 2007) and Gram negative bacteria such as Salmonella (Orsi et al., 2005).[7-9] The effect of Propolis on growth and glucosyl transferase activity of Streptococcus sorbinus, Streptococcus mutans and Streptococcus circuits was observed in vitro and in vivo (Ikeno et al., 1991) and found that the insoluble glycan synthesis and glucosyl transferase activity were inhibited by multiple actions of Propolis.[10]

Kujumgiev et. al. (1999) evaluated antibacterial (S. aureus and Escherichia coli), antifungal (Candida albicans) and antiviral (Avian influenza virus) properties of Propolis and found to be very effective.[11] Propolis have better antioxidant property than vitamin C which protects against gamma radiation that is attributed to its radical scavenging ability.[12] Anti-inflammatory property of Propolis is due to the presence of caffeic acid phenethyl ester (CAPE) (Borrelli et al., 2002).[13] Propolis is dispensed in various forms such as tooth paste, mouthwash, lozenges, wine, cake, powder, jelly, tablets, soap and others. This paper reviews various potential uses of propolis in dentistry.

Uses of Propolis in Dentistry

In treatment of oral cancer

Propolis is a powerful antioxidant. This effect is due to the high concentration of phenolics and other antioxidant compounds. The radical theory in human physiology claims that the active free radicals are involved in almost all the cellular degradation process and leads to cell death. Oxidative stress is thought to contribute to the development of chronic and degenerative diseases such as cancer. Propolis is regarded as a supplement for preventing chronic degeneration diseases, e.g. oral cancer.[14] CAPE (cafeic acid phenethyl ester) is a strong antioxidant bioactive component extracted from honeybee hive Propolis with no known toxic effects. The administration of CAPE is a potential adjuvant therapy for patients with oral squamous cell carcinoma (OSCC). CAPE treatment suppresses the cell proliferation and colony formation of human cancer cells. It may enhance the regression of tumors and reduce the required dosage of 5-fluorouracil (5-FU) (a commonly used chemotherapeutic drug for oral cancers).[15] CAPE and artepillin C (immunopotent chemical) have potential antitumor properties through different postulated mechanisms such as suppressing cancer cells proliferation via its anti-inflammatory effects, decreasing the cancer stem cell populations, blocking specific oncogene signaling pathways, exerting anti-angiogenic effects, and modulating the tumor microenvironment. The good bioavailability by the oral route and good historical safety profile makes propolis an ideal adjuvant agent for the future immunomodulatory or anticancer regimens.[16]

Wound healing

Due to high caries activity, low socioeconomic status and insufficient knowledge about the importance of oral health, tooth extraction becomes the treatment of choice for such individuals. Extraction wound could be painful as wound healing acceleration may alleviate pain. The effects of 30% Propolis on the population of mast cells in oral surgical wounds of hamsters were studied in comparison with 0.1% dexamethasone in orabase cream. The anti-inflammatory action of Propolis mediated by mast cells was more effective than dexamethasone in the inflammatory phase of healing.[17]

Mouth rinse

Propolis-based solutions have lower cytotoxic effect on the fibroblasts of human gum than chlorhexidine, which predisposes them to be used as ingredient of mouthwashes.[18] A study done by Murray indicated that the effect of Propolis extract on reducing bacterial plaque growth was slightly better than the

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chlorhexidine group; however, statistically it was negligible.[19] Propolis can be also used in a form of a solution to decontaminate bristles of toothbrushes.[20]

Halitosis

Halitosis is largely related to hygiene of the oral cavity. The by products of degradation of microorganisms present in the mouth are the reasons for bad breath.[21] Microbes particularly related to the creation of bad breath include the red complex bacteria (Prevotella intermedia, Porphyromonas endodontalis and Eubacterium).[22] Sterer et. al. conducted a study on the effect of Propolis mouth wash on halitosis, results showed that after the use of Propolis there was decrease in the amount of volatile sulfur components in exhaled air. He concluded stating that Propolis helps in reducing halitosis.[23]

Herpes infection

Herpes simplex virus which causes a disease of oral mucosa is one of the most common human pathogens.[24] In cases of infection caused by this virus, attempts were made to use Propolis-based extracts in its treatment. The use of Propolis solutions by Schnitzler et. al. disclosed that bee glue has high antiviral effect. The antiviral effect of single component of Propolis is not same as the effect produced by a mixture in the form of bee glue which accounts for the use of Propolis extract directly on the lesion caused by the infection.[25] A research done by Shimizu et. al. indicates that Propolis delays growth and progression of skin changes in an early stage of infection with Herpes simplex .[26]

Recurrent aphthous stomatitis

It is a common painful and ulcerative condition of the oral cavity. Bee glue turned out to be effective in the treatment, as it reduces the frequency of recurrence of the disease and also improves the quality of life of patients who suffer from recurrent stomatitis. Bee glue-based preparations are also useful for the treatment of stomatitis caused by chemotherapy as it has antioxidant property.[27]

Dental caries

The main cariogenic bacterium for the development of dental caries is Streptococcus mutans followed by Lactobacillus species. Virulence of Streptococcus mutans results from its ability for adhesion, acid-forming properties and tolerance to environment with low pH.[28] In 1991, Ikeno et. al. proved that Propolis considerably reduces dental caries as the result of its multidirectional influence on bacterial flora. It limits the number of microorganisms by slowing down the synthesis of insoluble glucans and activity of glucosyltransferase.[29] Duarte et. al. explained cariostatic effects of Propolis by high quantity of fatty acids which slow down the production of acids by Streptococcus mutans and decreases the tolerance of microorganisms to acid pH.[30] Propolis slows down the formation of precipitates of calcium phosphates due to which, it can be used as ingredient in mouthwashes or toothpastes in order to inhibit the initiation of dental caries.[31]

Direct pulp capping

Direct pulp capping is done after accidental, mechanical or chemical exposure of pulp in order to stimulate the pulp to create reparative dentin. The regenerative effect of Propolis on the tooth pulp has been known for a long time.[32] Bretz et. al. stated that there are no important differences in direct capping with Propolis and calcium hydroxide based products. Both of them offer a similar degree of healing pulp inflammation, reducing quantity of microbes and stimulating creation of dentin bridge.[33] Ahangari et. al. stated that direct pulp capping with Propolis showed higher effectiveness than with calcium hydroxide-based products. It not only stops inflammatory reaction, infections caused by microbes and pulp necrosis but also induces formation of high quality tubular dentin through stimulation of stem cells.[34] According to Sabir et. al. the stimulative effect on dental pulp is conditioned by presence of flavonoids in Propolis extracts.[35]

Intracanal medicaments

One of the aims of endodontic treatment is complete elimination of microbes in root canals. Effectiveness of medicines used in endodontics is often assessed through a test of Enterococcus faecalis growth which is resistant to unfavorable environment and can survive in the root canal system despite application of medicaments.[36] According to Kayaoglu et. al. propolis

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effectively limits the quantity of E. faecalis in root canals as it exhibits good antibacterial and anti-inflammatory activity.[37] A comparative study was done to evaluate Propolis and triantibiotic mixture as an intracanal medicament and was concluded that Propolis was more effective than triantibiotic mixture.[38] Lama Awawdeh et.al. compared Propolis and calcium hydroxide as an intracanal medicament against E. feacalis. Propolis showed better results than calcium hydroxide in reducing the bacterial count.[39]

Storage media following avulsion

Maintenance of healthy periodontal cells is one of the crucial factors that condition a successful replantation of an avulsed permanent tooth. For this reason, many studies were conducted in order to find the best means to transport the completely avulsed teeth. In the study done by Goswami et. al. Propolis turned out to be a better means for storing avulsed tooth than milk or Hank's Balanced Salt Solution.[40] A study was conducted comparing milk and Propolis as storage media for 6 hours before reimplantation, where Propolis showed better results than milk.[41] The antibacterial and anti-inflammatory actions of Propolis demonstrate their capacity to inhibit prostaglandin synthesis, aiding the immune system in the phagocytic activity and promoting healing effects in the epithelial tissue.[42],[43] Additionally, one or more antioxidant composites in these substances may increase the success rate of tooth replantation because they prevent the harmful effects of the free radicals, modulating the osteoblast and osteoclast activity.[44] Propolis also contains iron and zinc, important for collagen synthesis, and bioflavonoids that help in the contention of hemorrhages of the PDL tissue and stimulate enzymes that fortify the walls of the blood vessels in the periodontium.[45]

Effect on Candida albicans

Denture stomatitis is frequently observed in patients who use removable dentures. Etiological factors of this disease include infection with Candida albicans which is caused due to poor oral hygiene and prolonged use of dental prosthesis. Propolis-based products have strong antifungal properties in relation to Candida albicans and to other types of Candida species.[46]

Other therapeutic uses

Propolis is also used in the treatment of common cold, acute and chronic inflammation of the upper respiratory tract, sinusitis, laryngitis (larynx inflammation), tonisillitis (infections of the tonsils), pulmonary tuberculosis, ulcers, healing of lesions caused due to cancer radiation treatments, bacterial infection and inflammation of the stomach and duodenum. Regular propolis consumption could have a preventive anticancer effect.[47]

Allergic reactions to Propolis

Allergic reactions may be seen as contact chelitis, contact stomatitis, peeling of lips, perioral eczema and labial edema. 3-methyl-2-butenyl caffeate and phenylethyl caffeate are responsible for the contact allergies. Walgrave reviewed different contact dermatitis studies and concluded that 1.2 to 6.6 % of the patients undergoing patch testing were sensitive to propolis.[48]

Contraindication

Propolis cannot be used by the individuals who are allergic to bee pollen, bee stings and asthmatic patients.[49]

CONCLUSION

Propolis-based preparations have a wide range of applications in various specialties of dentistry, thanks to the richness of its natural components. Bee glue has their unique properties such as antibacterial, antiviral, antifungal, anti-inflammatory, analgesic and many other applications. Though Propolis has shown very promising results clinician should be cautious while using this material due to its allergic reactions shown in some individuals.

REFERENCES

1. Cran, E. The world history of beekeeping and honey hunting,Gerald Duckworth & Co Ltd; London,1999; 545-553.
2. Greenaway W, Scasbroock T, Whatley .The composition and plant origins of propolis: A report of work at Oxford. Bee World, 1990; 71: 107-8.

ISSN: 2456-3110 REVIEW ARTICLE Jan-Feb 2017

3. Ghisalberti EL . Propolis: A review. Bee World, 1979; 60: 59-84.
4. Gonzalez M, Guzman B, Rudyk R, Romano E, Molina MA. Spectrophotometric determination of phenolic compounds in popolis. Acta Farm Bonaerense, 2003; 22: 243-8.
5. Park YK, Alencar SM, Aguiar CL . Botanical origin and chemicalcomposition of Brazilian propolis. J. Agric. Food Chem.,2002; 50: 2502-2506.
6. Almas K, Dahlan A, Mahmoud A . Propolis as a natural remedy: An update. Saudi Dental J. 2001;13: 45-49.
7. Seidel V, Peyfoon E, Watson DG, Fearnley J . Comparative study of the antibacterial activity of propolis from different geographical and climatic zones. Phytother. Res.,2008; 22: 1256-1263.
8. Velazquez C, Navarro M, Acosta A, Angulo A, Dominguez Z, Robles R, Robles-Zepeda R, Lugo E, Goycoolea FM,Velazquez EF, Astiazaran H, Hernandez J. Antibacterial and free-radical scavenging activities of Sonoran propolis. Appl. Microbiol., 2007;103: 1747-1756.
9. Orsi R O, Sforcin J M , Rall V L M , Funari S R C, Barbosa L, Fernandes JR A . Susceptibility profile of Salmonella against the antibacterial activity of propolis produced in two regions of Brazil. J. Venomous Anim. Toxins including Trop. Dis. 2005;11: 109-116
10. Ikeno K, Ikeno T, Miyazawa C . Effect of Propolis on dental caries in rats. Caries Res.1991; 25: 347-351.
11. Kujumgiev A, Tsvetkova I, Serkedjieva Y, Bankova V, Christov R,Popov S . Antibacterial, antifungal and antiviral activity of propolis of different geographic origin. J. Ethnopharmacol.,1999; 64: 235-240.
12. Krol W, Czuba Z, Scheller S, et al . Antioxidant property of ethanolic extract of propolis (EEP) as evaluated by inhibiting the chemiluminescence oxidation of luminol. Biochem Int,1990; 21:593 -597
13. Borrelli F, Maffia P, Pinto L, Ianaro A, Russo A, Capasso F, Ialenti A Phytochemical compounds involved in the anti-inflammatory .effect of propolis extract. Fitoterapia.2002; 73: 53-63.
14. Pham-huy. Free Radicals, Antioxidants in Disease and Health. Int.J.Biomed.Sci.2008; 4: 89-96.
15. Kuo YY, Lin HP, Huo C, Su LC, Yang J, Hsiao PH, et al. Caffeic acid phenethyl ester suppresses proliferation and survival of TW2.6 human oral cancer cells via inhibition of akt signaling. Int J Mol Sci. 2013;14:8801–17.
16. Chan GC, Cheung KW, Sze DM. The immunomodulatory and anticancer properties of propolis. Clin Rev Allergy Immunol. 2013;44:262–73.
17. Magro-Filho O, de Carvalho AC . Topical effect of Propolis in the repair of sulcoplasties by the modified Kazanjian techniques. Cytological and clinical evaluation. J. Nihon Univ. School Dentistry. 1994;36: 102-111.
18. Ozan F, Sümer Z, Polat ZA, Er K, Ozan U, De_er O . Effect ofmouth rinse containing propolis on oral microorganisms and human gingival fibroblast. Eur. J. dentistry. 2007;11:195-200.
19. M. C. Murray, “A study to investigate the effect of a propoliscontaining mouthrinse on the inhibition of de novo plaque formation,” Journal of Clinical Periodontology 1997;24 :796–798.
20. P. F. Bertolini, O. Biondhi Filho, A. Pomilio, S. L. Pinheiro, and M. S. Carvalho, “Antimicrobial capacity of Aloe vera and propolis dentifrice against Streptoccocus mutans strains in toothbrushes: an in vitro study,” Journal of Applied Oral Science 2012; 20: 32–37.
21. W. J. Loesche, “The effects of antimicrobial mouthrinses on oral malodor and their status relative to US Food and Drug Administration regulations,” Quintessence International, 1999;30(5):311–318,
22. Van den Broek, L. Feenstra, and C. De Baat, “A review of the current literature on management of halitosis,”Oral Diseases, 2008;14:30–39,
23. N. Sterer and Y. Rubinstein, “Effect of various natural medicinal on salivary protein putrefaction and malodor production,”Quintessence International, 2006; 37(8): 653–658.
24. A. Jamali, M. H. Roostaee, H. Soleimanjahi, F. Ghaderi Pakdel, and T. Bamdad, “DNA vaccine-encoded glycoprotein B of HSV-1 fails to protect chronic morphine-treated mice against HSV-1 challenge,” Comparative Immunology, Microbiology and Infectious Diseases, 2007;30(2):71–80,
25. P. Schnitzler, A. Neuner, S. Nolkemper et al., “Antiviral activity and mode of action of propolis extracts and selected compounds,” Phytotherapy Research, 2010; 24(1): 20–28.
26. T. Shimizu, Y. Takeshita, Y. Takamori et al., “Efficacy of brazilian propolis against Herpes Simplex Virus type 1

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infection in mice and their modes of antiherpetic efficacies," Evidence- Based Complementary and Alternative Medicine, 2011;9: 976-196.

27. M. Abdulrhman, N. S. El Barbary, D. A. Amin, and R. S. Ebrahim, "Honey and a mixture of honey, beeswax and oliveoil- propolis extract in treatment of chemotherapy induced oral mucositis: a randomized controlled pilot study," Pediatric Hematology and Oncology, 2012;29(3) :285–292. .
28. J. A. Banas, "Virulence properties of Streptococcus mutans," Frontiers in Bioscience, 2004; 9:1267–1277.
29. K. Ikeno, T. Ikeno, and C. Miyazawa, "Effects of propolis on dental caries in rats," Caries Research, 1991; 25(5):347–351.
30. S. Duarte, P. L. Rosalen, M. F. Hayacibara et al., "The infuence of a novel propolis on mutans streptococci bioflms and caries development in rats," Archives of Oral Biology, 2006;51(1) :15–22.
31. S. Hidaka, Y. Okamoto, K. Ishiyama, and K. Hashimoto, "Inhibition of the formation of oral calcium phosphate precipitates: the possible effects of certain honeybee products," Journal of Periodontal Research, 2008;43(4):450–458.
32. S. Scheller, L. Ilewicz, and M. Luciak, "Biological properties and clinical application of propolis. IX. Experimental observation on the infuence of ethanol extract of propolis (EEP)on dental pulp regeneration," Arzneimittel-Forschung/Drug Research,1978;28(2): 289–291.
33. W. A. Bretz, D. J. Chiego Jr, M. C. Marcucci, I. Cunha, A. Custodio, and L. G. Schneider, "Preliminary report on the effects of propolis on wound healing in the dental pulp," Zeitschrift fur Naturforschung C, 1998; 53:11(12): 1045–1048.
34. A. Parolia, M. Kundabala, N. N. Rao et al., "A comparative histological analysis of human pulp following direct pulp capping with Propolis, mineral trioxide aggregate and Dycal,"Australian Dental Journal, 2010; 55: 59–64.
35. A. Sabir, C. R. Tabbu, P. Agustiono, and W. Sosroseno,"Histological analysis of rat dental pulp tissue capped with propolis," Journal of Oral Science, 2005; 47.(3)135–138.
36. A. Byström and G. Sundqvist, "Bacteriologic evaluation of the efficacy of mechanical root canal instrumentation in endodontic therapy," Scandinavian Journal of Dental Research, 1981; 89:321–328.
37. G. Kayaoglu, G. Ömürlü, G. Akca et al., "Antibacterial activity of Propolis versus conventional endodontic disinfectants against Enterococcus faecalis in infected dentinal tubules," Journal of Endodontics, 2011; 37: 376–381.
38. Madhubala M, Srinivasan N, Ahamed S. Comparative evaluation of propolis and triantibiotic mixture as an intracanal medicament against Enterococcus faecalis. J Endod. 2011 Sep;37(9):1287-9.
39. Lama Awawdeh, Maha AL-Beitawi, Hammad Effectiveness of propolis and calcium hydroxide as a short-term intracanal medicament against *Enterococcus faecalis*: A laboratory study. Australian Endodontic Journal 2009; 35(2):52-58
40. M. Goswami, T. Chaitra, S. Chaudhary, N. Manuja, and A. Sinha, "Strategies for periodontal ligament cell viability: an overview," Journal of Conservative Dentistry, 2011; 3,: 215–220.
41. Mori GG, Nunes DC, Castilho LR, de Moraes IG, Poi WR. Propolis as storage media for avulsed teeth: Microscopic and morphometric analysis in rats. Dent Traumatol 2010;26:80-5. Baweja PS, Venkateshbabu N, Thomas T, KandaswamyD. Comparison of coconut water, propolis, HBSS, and milk on PDL cell survival. J Endod 2008;34:587-589.
42. Gopikrishna V, Thomas T, Kandaswamy D. A quantitative analysis of coconut water: a new storage media for avulsed teeth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:61-65.
43. Malhotra N. Current developments in interim transport (storage)media in dentistry: an update. Br Dent J 2011;211:29-33.
44. O. Magro-Filho and A. C. de Carvalho, "Topical effect of propolis in the repair of sulcoplasties by the modifed Kazanjian technique. Cytological and clinical evaluation," The Journal of Nihon University School of Dentistry, 1994; 36: 102–111.
45. Martin MP, Pileggi R. A quantitative analysis of propolis: a promising new storage media following avulsion. Dent Traumatol 2004;20:85-89.
46. C. Ota, C. Unterkircher, V. Fantinato, and M. T. Shimizu, "Antifungal activity of propolis on different species of Candida,"Mycoses, 2001;44: 375–378.

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47. Ribeiro, salvadori, dietary components may prevent mutation-related diseases in humans. Mutation research-reviews in mutation research 2003;544 (2-3): 195-201.
48. Walgrave,warshaw, (2005) allergic contact dermatitis from propolis.dermatitis 2005;16 (4): 209-215.
49. Hay, k d, Greig, Propolis allergy: a cause of oral mucositis with ulceration. Oral surgery, oral medicine, and oral pathology 1990;70 (5): 584-586.

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