

HERBAL CARE IN DENTISTRY- A REVIEW OF EMERGING TRENDS

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ABSTRACT

Herbs are staging a comeback and herbal ‘renaissance’ is happening all over the globe. The herbal products, today, symbolize safety, in contrast to the synthetics that are regarded as unsafe to humans and the environment. An herb, botanically speaking, is any plant that lacks the woody tissue which is characteristic of shrubs or trees. More specifically, herbs are plants which are used medicinally or for their flavor or scent. Herbs with medicinal properties are a useful and an effective source of treatment for various disease processes. Herbal extracts have been successfully used in dentistry as tooth cleaning and antimicrobial plaque agents. The use of herbal medicines continues to expand rapidly across the world. Many people take herbal medicines or herbal products now for their health care in different national healthcare settings. Herbal extracts have been used in dentistry for reducing inflammation, as antimicrobial plaque agents, for preventing release of histamine and as antiseptics, antioxidants, antimicrobials, antifungals, antibacterials, antivirals and analgesics. They also aid in healing and are effective in controlling microbial plaque in gingivitis and periodontitis, thereby improving immunity.

KEYWORDS- Bacterial plaque; Dental health; Gingivitis; Herbal medicine.

INTRODUCTION

Humans have sought cures for diseases in nature since ancient times; even recently, the use of herbal medicines in dietary supplements, energy drinks, multivitamins, massage, and weight loss products has gained popularity¹. These uses have broadened the field of herbal medicine and also increased its credibility.

Practitioners and consumers of complementary and alternative medicine (CAM) are no longer at the periphery of clinical practice². Herbal medicine is a popular form of CAM³. Herbs, botanically speaking, are any plants that lack the woody tissue

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characteristic of shrubs or trees. More specifically, herbs are plants used medicinally or for their flavor or scent⁴.

Herbs are used to cleanse the blood, warm and stimulate the body, increase surface circulation, increase elimination of wastes, reduce inflammation, and calm and soothe irritation. Herbs may be used internally as pills, syrups, and

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infusions, or externally as poultices, plasters, and liniments⁵. Many drugs used in Western medical science called allopathic medicine have their origin in medicinal plants^{6,7}.

According to the World Health Organization (WHO), as many as 80% of the world's people depend on traditional medicine (herbal) for their primary healthcare needs. The development of indigenous medicines and the use of medicinal plants carry considerable economic benefits in the treatment of various diseases⁸. In the developed countries, 25% of the medical drugs are based on herbs and their derivatives^{5,9}.

Herbal extracts are effective because they interact with specific chemical receptors within the body and are in a pharmacodynamic sense, drugs themselves¹⁰. Any discussion the health professional has with a patient about herbal supplements should be conducted with caution. The plant extracts affecting inflammation and bleeding are of significant interest to the dental professional¹¹. Therefore, factual knowledge is essential.

Dental fraternity has also witnessed impact of these herbal medicines as a regular constituent of dental medicine to dental problems in the form of toothpastes, gum paints to name a few. Also, herbal remedies have a long history of use for gum and tooth problems¹². In many traditional cultures, the use of herbal "chewing sticks" taken from plants, shrubs or trees with high antimicrobial activity are common. An herb may exhibit one or more following unique therapeutic properties like anti-bacterial, anti-inflammatory, astringents, anaesthetic, immune straighteners, anticariogenic, storage media for avulsed tooth, anti-plaque agents, root canal irrigants, and tooth whitener etc¹³⁻¹⁵.

Since tooth brushing is the most basic process in oral care, indigenous people, the world over, use natural tooth brushes which are made from healing plants¹⁶. These primitive twig 'brushes' actually work quite well and they provide natural-bristle,

disposable brushes with healing ingredients which have already been incorporated right in the plants¹⁷.

Today, more than 90% of school children and a large proportion of adults have dental caries in many parts of the world¹⁸. This indicates the need for improved diagnostic and therapeutic procedures in dentistry, especially in children. On the other hand, misuse and overuse of antibiotics are increasing¹⁹. Use of synthetic drugs, especially in children, can have adverse effects such as liver complications²⁰. A study conducted on irrigating solutions showed that chlorhexidine (CHX) causes tooth discoloration, creates a burning sensation in the mouth and results in loss of taste²¹. Sodium hypochlorite can cause allergy and tissue toxicity and calcium hydroxide cannot efficiently remove bacteria from the dentinal tubules^{22,23}. Moreover, not all people have access to synthetic drugs and thus, they may use herbal medicines as alternatives²¹.

There is an urgent need for a use of Evidence Based Herbal Medicine and the efficacy and safety of herbal remedies. This article aims to review the most commonly used herbs in dentistry.

Bloodroot (Botanical name: *Sanguinaria canadensis*)

Alkaloids – principally sanguinarine – constitute the primary active compounds in bloodroot. These are used for gingivitis and periodontal disease and sometimes used in toothpaste or other oral hygiene products because they inhibit the growth of oral bacteria^{24,25}. Bloodroot tincture is sometimes included in cough relieving formulas, and 10 drops or less may be taken three times per day²⁶.

A recent report suggests that use of dental preparations containing blood root may be associated with leucoplakia – a condition characterized by white spots or patches in the mouth that is thought to be precancerous^{27,28}. Only small amounts of bloodroot should be taken, since amounts as small as 1 ml of tincture or 1 g can

cause nausea and vomiting²⁹. Long-term use or overdose of bloodroot can also cause stomach pain, diarrhoea, visual changes, paralysis, fainting, and collapse. Long-term oral intake of sanguinarine-contaminated cooking oils has been linked in India to glaucoma, oedema, heart disease, miscarriage, and diarrhoea^{29,30}.

Caraway (Botanical name: *Carum carvi*)

Caraway contains 3–7% volatile oil, with the main components divided into carvone (50–60%) and limonene (40%)¹⁰. Caraway may help in gingivitis or periodontal disease (as a mouth wash). The purified volatile oil should not be used by children under 2 years of age, as oil from caraway and other herbs in the Umbelliferae family can be irritating to the skin and mucous membranes³¹.

Clove (*Syzygium aromaticum*)

The molecule named eugenol in clove essential oil has analgesic and antiseptic properties and particularly inhibits growth of nearly all disease-causing bacteria while leaving the beneficial bacteria unharmed³². It has been used in dental fillings, and dental cements for many years for their topical analgesic properties. The eugenol and other constituents of clove, such as vanillin and isoeugenol, have also been reported to have antimicrobial effect³³. Clove gel can provide dentists with an alternative to benzocaine for topical anaesthesia in their daily practice

Tea tree oil

Tea tree oil's major active component is terpinen-4-ol (30%–40%). This compound is responsible for its antibacterial and antifungal properties³⁴. Using tea tree oil orally is not recommended as it may cause possibly serious side effects such as confusion, loss of muscle control, or coma³⁵. In dentistry, tea tree oil has been used to destroy microorganisms in the mouth before dental surgery, removal of smear layer when used as a root canal irrigant and to relieve mouth soreness caused by dental procedures³⁶⁻³⁹. In studies of patients who

suffered from oral candidiasis, mouth rinses containing tea tree oil have shown some effectiveness in reducing symptoms^{40,41}.

Coconut water

Coconut water's unique nutritional profile makes an excellent oral rehydration, enhances immune function, possesses anti-aging properties, decreased swelling, relieve spasm, root canal irrigant (antiviral, antifungal and antimicrobial properties) and storage media for avulsed tooth⁴². A new storage media, coconut water, in maintaining viable periodontal ligament (PDL) cells on avulsed teeth, may be a better alternative to Hank's Balanced Salt Solution or milk in terms of maintaining PDL cell viability after avulsion and storage^{43,44}.

Tulsi

A literature review by Mahantesh p et al (2011) elaborated the role of tulsi in the medicinal field, in addition stating that it has an effective antibacterial potential to conflict with the oral pathogens. Their components like ursolic acid and carvacrol are known to be responsible for the antimicrobial activity of tulsi. A review by Chirag Modi et al (2012) has determined that these plant extracts were more active against gram positive than against gram negative bacteria. A study done by Pooja Agarwal et al (2010) has demonstrated an antimicrobial activity of tulsi extract against *Streptococcus mutans* which is maximum at 4% concentration level⁴⁵.

Liquorice Root (*Glycyrrhiza glabra*)

Liquorice root contains glycyrrhizol A, a compound that has strong antimicrobial activity against cariogenic bacteria. Two pilot human studies indicate that a brief application of lollipop containing liquorice roots led to a marked reduction of cariogenic bacteria in the oral cavity. Further studies have to be done to show that liquorice compounds can be used as a cavity fighting component in mouthwash or toothpaste⁴⁶.

Cinnamon zeylanicum

Cinnamon extract irrigant shows better reduction in *E. faecalis* as compared to three percent of sodium hypochlorite and neem extract irrigant⁴⁷. The sugar sweetened cinnamon chewing gum may benefit halitosis by reducing volatile sulphur compounds producing anaerobes within the mouth. The Ethanolic extracts which are prepared from Tooth brush tree (Miswak) and *Cinnamomum Zeylanicum* (Ceylon cinnamon), by the soxhlet method showed variable antibacterial activity against periodontal pathobionts. Both Cinnamon and chlorhexidine used as an irrigant through Dental Unit Water lines (DUWL) effectively helped within the reduction of bacterial count in dental aerosols during Ultrasonic scaling.

Phyllanthus emblica

Emblica officinalis berry possesses varied medicinal properties including cytoprotective, antimicrobial, antioxidant, antiresorptive and anti-inflammatory activity. Locally delivered ten percent of *E. officinalis* gel used as an adjunct to Scaling and root planing (SRP) could also be simpler in reducing inflammation and periodontal destruction in patients with chronic periodontitis in compared with SRP alone. The Ethanolic extract of *Phyllanthus Emblica* performs significantly lower numbers of all strains of yeasts adhering to human buccal epithelial cells (BECs) and acrylic strips compared with Normal saline solution (NSS).

Chamomile

The flowers of chamomile contain 1–2% volatile oils. Other active constituents include the flavonoids, apigenin, luteolin, and quercetin. These active ingredients contribute to chamomile's anti-inflammatory, antispasmodic, and smooth-muscle relaxing action, particularly in the gastrointestinal tract⁴⁸⁻⁵⁰. Allergic reactions to chamomile have been reported. These reactions have included bronchial constriction with systemic use and allergic skin reactions with topical use⁵¹.

***Echinacea* (Common name: Purple coneflower)**

Echinacea is thought to support the immune system by activating white blood cells⁵². The mouth wash of Echinacea is effective in gingivitis and periodontal disease in combination with sage, peppermint oil, menthol and chamomile⁵³.

***Myrrh* (Botanical name: *Commiphora molm*)**

The three main constituents of myrrh are the resin, the gum, and the volatile oil. The resin has reportedly been shown to kill various microbes and to stimulate macrophages. Myrrh also has astringent properties and has a soothing effect on inflamed tissues in the mouth and throat. Studies continue on the potential anticancer and pain-relieving actions of myrrh resin^{54,55}. Myrrh is used for topical treatment of mild inflammations of the oral and pharyngeal mucosa. It is also used as a gargle to treat pharyngitis and tonsillitis and as a mouthwash for gingivitis and ulcers. Topical use is approved for the treatment of small wounds, for nasal congestion from the common cold, and for local application as an anodyne to treat infections of the buccal cavity and/or the oropharynx^{56,57}.

***Rosemary* (Botanical name: *Rosmarinus officinalis*)**

This volatile oil, including eucalyptol (cineole), is considered a potent antibacterial agent, it is effective in chronic candidiasis⁵⁸. Rosmarinic acid has antioxidant activity and another ingredient of rosemary, known as carnosol, has been shown to inhibit cancer formation in animal studies⁵⁹. The oil possesses antibacterial and antifungal properties, and antimicrobial activity has been documented towards molds, Gram-positive and Gram-negative bacteria including *Staphylococcus aureus*, *Staphylococcus albus*, *Vibrio cholerae* and *Escherichia coli*. Frequent use of rosemary could, in theory, promote the development of iron deficiency in susceptible individuals⁶⁰.

Sage (Botanical name: *Salvia officinalis*)

The volatile oil of sage contains the constituent alpha and beta-thujone, camphor, and cineole^{59,61}. It also contains rosmarinic acid, tannins and flavonoids. In modern European herbal medicine, a gargle of sage tea is commonly recommended to treat a sore throat, inflammation in the mouth, and gingivitis⁶². Sage oil has antibacterial, antifungal, and antiviral activity which may partially explain the effectiveness of sage for these indications.

Aloe vera

Aloe vera gel formula is nontoxic, bactericidal, veridical, and fungicidal against a broad range of microorganisms, and a stimulator of cellular life extension.

There are eight main uses of Aloe Vera in dental practice:

- Applications directly to the the sites of periodontal surgery
- Applications to the gum tissues when they have been traumatized or scratched by toothbrush dentifrice abrasion, sharp foods, dental floss, and toothpick injuries
- Relief of chemical burns are relieved quickly from accidents with aspirin
- Extraction sites respond more comfortably and dry sockets do not develop when aloe vera is applied
- Acute mouth lesions are improved by direct application such as on herpetic viral lesions, aphthous ulcers, canker sores, and cracks occurring at the corners of lips¹⁵. Gum abscesses are also soothed by the applications
- Other oral diseases, chronic in nature, respond to applications such as lichen planus and benign pemphigus and gingival problems associated with AIDS and leukaemia. Migratory glossitis,

geographic tongue and burning mouth syndrome are improved.

- Denture patients with sore ridges and ill-fitting dentures can benefit as fungal and bacterial contamination is reduced as is the irritation from inflammation
- Aloe vera can also be used around dental implants to control inflammation from bacteria contamination¹⁵.

Miswak (*Salvadora persica*)

The chewing stick (miswak) is used for oral hygiene in many parts of the world. In addition to the mechanical removal of plaque, an antibacterial effect has also been postulated. Fatemah et al (2010) showed that rate of caries decreases after using miswak and this can be due to antimicrobial effects. Almas et al (2004) in a study investigated the antimicrobial effects of miswak compared with toothbrush and their results showed that in miswak users there was a significant decrease in streptococcus.

Babool (*Acacia nilotica*)

Babool has been used for dental problems and used as a great astringent and is equally useful as dentifrice, anti-hemorrhagic agent. The extracts of babul can reduce the ability of some streptococci to colonize tooth surfaces. Mohan lal sainsi et al (2008) performed a comparative study on the microbial activity of acacia species and found that *A. nilotica* exhibited the highest activity against staphylococcus aureus and salmonella Typhi. Bansa A et al (2008) assessed that the minimal bactericidal concentration of stem bark extract of the plant against different bacteria ranged from 35-60 mg/ml.

Cranberry (*Vaccinium oxycoccus*)

Cranberry has been recognized for its beneficial effects on human health. Cranberry constituents

prevent adhesion of oral pathogens to tooth surface⁶³. Yamanaka and colleagues assessed the effect of cranberry juice on the ability of several oral species of streptococcus to adhere to hydroxyapatite pellets that had been pretreated with saliva. When the bacteria were exposed to cranberry juice, their adhesion to the pellets decreased significantly⁶⁴.

Neem (*Azadirachta indica*)

Neem has been extensively used in ayurveda, unani and homeopathic medicine⁶⁵. Neem is considered as a resourceful medicinal plant having a wide spectrum of biological activity. Each of its components has several actions such as its fluoride content is known to exhibit maximum antimicrobial activity against *Streptococcus mutans*. Tannins exert an astringent effect and form a coat over the enamel, thus protecting against tooth decay. The use of neem twigs as toothbrush has been endorsed by the dentists to prevent caries^{65,66}.

The inhibitory effects of neem upon bacterial growth, adhesion on hydroxyapatite on tooth surface, and production of insoluble glucan suggests that neem stick extracts can reduce the ability of some streptococci to colonize tooth surfaces, and useful as anti caries products⁶⁶.

CONCLUSION

Herbs have the potential to be developed into agents that can be used as preventive or curative agents for dental caries and also as antimicrobial plaque agents, antiseptics, antioxidants, antimicrobials, antifungal and analgesics.

Due to the side effects and disadvantages of synthetic drugs, the use of medicinal plants is increasing considering their low cost, availability and biocompatibility. Further studies on types of suitable medicinal plants, their use and dosage are required especially in children to know more about their toxicity and possible side effects.

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REFERENCES

1. Petrovska BB. Historical review of medicinal plants' usage. *Pharmacogn Rev.* 2012 Jan;6(11):1–5.
2. Marshall RJ, Gee R, Israel M, Neave D, Edwards F, Dumble J, et al. The use of alternative therapies by Auckland general practitioners. *N Z Med J.* 1990 May 9;103(889):213–5.
3. Russell D, Wilson N, Parnell W, Faed J, University of Otago. LINZ Activity & Health Research Unit, New Zealand. Ministry of Health. NZ Food, NZ People: Key Results of the 1997 National Nutrition Survey. 1999. 268 p.
4. Shavakhi M, Sahebkar A, Shirban F, Bagherniya M. The efficacy of herbal medicine in the treatment of recurrent aphthous stomatitis: A systematic review of randomized clinical trials. *Phytother Res.* 2022 Feb;36(2):672–85.
5. Balhaddad AA, Mokeem L, Melo MAS, Gregory RL. Antibacterial Activities of Methanol and Aqueous Extracts of against Biofilms: An In Vitro Study. *Dent J [Internet].* 2021 Dec 1;9(12). Available from: <http://dx.doi.org/10.3390/dj9120143>
6. Duke JA. *Handbook of Medicinal Herbs, Second Edition.* CRC Press; 2002. 896 p.
7. Rotblatt M, Ziment I. *Evidence-based Herbal Medicine.* 2002. 464 p.
8. Azaizeh H, Fulder S, Khalil K, Said O. Ethnobotanical knowledge of local Arab practitioners in the Middle Eastern region. *Fitoterapia.* 2003 Feb;74(1-2):98–108.
9. Safarzadeh S, Shirban F, Bagherniya M, Sathyapalan T, Sahebkar A. The effects of herbal medicines on cancer therapy-induced oral mucositis: A literature review. *Phytother Res.* 2022 Jan;36(1):243–65.
10. Hirata K, Yamada Y, Hamamoto Y, Tsunoda K, Muramatsu H, Horie S, et al. Prospective feasibility study of indigo naturalis ointment for chemotherapy-induced oral mucositis. *BMJ Support Palliat Care [Internet].* 2021 Oct 14; Available from: <http://dx.doi.org/10.1136/bmjspcare-2021-003199>
11. Amin M, Babadi F, Baghipour N, Sadeghi-Nejad B. Evaluation of the effect of Jaftex herbal mouthwash on the growth of and. *J Family Med Prim Care.* 2021 Oct;10(10):3815–9.
12. Suresh S, Arumugham IM, Doraikannan S, Rathinavelu PK, Prabakar J, Balasubramaniam A. Comparing the Effectiveness of Herbal and Conventional Dentifrices in Reducing Dental Plaque and Gingivitis: A Systematic Review. *J Int Soc Prev Community Dent.* 2021 Nov;11(6):601–8.
13. Little JW. Complementary and alternative medicine: impact on dentistry. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2004 Aug;98(2):137–45.
14. Zlotogorski Hurvitz A, Littner M. [Potential risks, adverse effects and drug interactions associated with herbal medicine in dental patients]. *Refuat Hapeh Vehashinayim.* 2004 Apr;21(2):25–41, 97.
15. Taheri JB, Azimi S, Rafieian N, Zanjani HA. Herbs in dentistry. *Int Dent J.* 2011 Dec;61(6):287–96.
16. Motallaei MN, Yazdanian M, Tebyanian H, Tahmasebi E, Alam M, Abbasi K, et al. The Current Strategies in Controlling Oral Diseases by Herbal and Chemical Materials. *Evid Based Complement Alternat Med.* 2021 Aug 21; 2021:3423001.
17. Al-Maweri SA, Warnakulasuriya S, Samran A. Khat (*Catha edulis*) and its oral health effects: An updated review [Internet]. Vol. 9, *Journal of Investigative and Clinical Dentistry.* 2018.

- Available from:
<http://dx.doi.org/10.1111/jicd.12288>
18. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. *Bull World Health Organ.* 2005 Sep;83(9):661–9.
19. Mojtahedzadeh M, Mashhadi Akbar Boojar M, Habtemariam S, Nabavi SM, Najafi A, Ghahremanian A, et al. Systematic review: Effectiveness of herbal oral care products on ventilator-associated pneumonia. *Phytother Res.* 2021 Jul;35(7):3665–72.
20. Zimmerman HJ. Hepatotoxicity. *Dis Mon.* 1993 Oct;39(10):675–787.
21. Murray PE, Farber RM, Namerow KN, Kuttler S, Garcia-Godoy F. Evaluation of *Morinda citrifolia* as an Endodontic Irrigant [Internet]. Vol. 34, *Journal of Endodontics.* 2008. p. 66–70. Available from:
<http://dx.doi.org/10.1016/j.joen.2007.09.016>
22. Prabhakar J, Senthilkumar M, Priya MS, Mahalakshmi K, Sehgal PK, Sukumaran VG. Evaluation of antimicrobial efficacy of herbal alternatives (Triphala and green tea polyphenols), MTAD, and 5% sodium hypochlorite against *Enterococcus faecalis* biofilm formed on tooth substrate: an in vitro study. *J Endod.* 2010 Jan;36(1):83–6.
23. Mohammadi Z. Sodium hypochlorite in endodontics: an update review. *Int Dent J.* 2008 Dec;58(6):329–41.
24. Dzik JL, Socransky SS. Comparative in vitro activity of sanguinarine against oral microbial isolates. *Antimicrob Agents Chemother.* 1985 Apr;27(4):663–5.
25. Hannah JJ, Johnson JD, Kuffinec MM. Long-term clinical evaluation of toothpaste and oral rinse containing sanguinarine extract in controlling plaque, gingival inflammation, and sulcular bleeding during orthodontic treatment. *Am J Orthod Dentofacial Orthop.* 1989 Sep;96(3):199–207.
26. *British Herbal Pharmacopoeia: British Herbal Medicine Association, Scientific Committee.* 1976.
27. Frankos VH, Brusick DJ, Johnson EM, Maibach HI, Munro I, Squire RA, et al. Safety of Sanguinarine extract as used in commercial toothpaste and oral rinse products. *J Can Dent Assoc.* 1990;56(7 Suppl):41–7.
28. Eversole LR, Eversole GM, Kopicik J. Sanguinarine-associated oral leukoplakia: comparison with other benign and dysplastic leukoplakic lesions. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2000 Apr;89(4):455–64.
29. Gardner Z, McGuffin M. *American Herbal Products Association's Botanical Safety Handbook, Second Edition.* CRC Press; 2013. 1072 p.
30. Hakim SA. Sanguinarine--a carcinogenic contaminant in Indian edible oils. *Indian J Cancer.* 1968 Jun;5(2):183–97.
31. Schilcher H. *Phytotherapy in Paediatrics: Handbook for Physicians and Pharmacists: with Reference to Commission E Monographs of the Federal Department of Health in Germany: Includes 100 Commission E Monographs and 15 ESCOP Monographs.* 1997. 181 p.
32. Meredith MJ. Herbal nutraceuticals: a primer for dentists and dental hygienists. *J Contemp Dent Pract.* 2001 May 15;2(2):1–24.
33. Moon SE, Kim HY, Cha JD. Synergistic effect between clove oil and its major compounds and antibiotics against oral bacteria. *Arch Oral Biol.* 2011 Sep;56(9):907–16.
34. Arweiler NB, Donos N, Netuschil L, Reich E, Sculean A. Clinical and antibacterial effect of tea tree oil--a pilot study. *Clin Oral Investig.* 2000 Jun;4(2):70–3.

35. Chauhan DN, Singh PR, Shah K, Chauhan NS. Natural Oral Care in Dental Therapy. John Wiley & Sons; 2020. 448 p.
36. Soukoulis S, Hirsch R. The effects of a tea tree oil-containing gel on plaque and chronic gingivitis. *Aust Dent J.* 2004 Jun;49(2):78–83.
37. Takarada K, Kimizuka R, Takahashi N, Honma K, Okuda K, Kato T. A comparison of the antibacterial efficacies of essential oils against oral pathogens. *Oral Microbiol Immunol.* 2004 Feb;19(1):61–4.
38. Catalán A, Pacheco JG, Martínez A, Mondaca MA. In vitro and in vivo activity of *Melaleuca alternifolia* mixed with tissue conditioner on *Candida albicans*. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2008 Mar;105(3):327–32.
39. Fritz TM, Burg G, Krasovec M. [Allergic contact dermatitis to cosmetics containing *Melaleuca alternifolia* (tea tree oil)]. *Ann Dermatol Venereol.* 2001 Feb;128(2):123–6.
40. Saxer UP, Stäuble A, Szabo SH, Menghini G. [Effect of mouthwashing with tea tree oil on plaque and inflammation]. *Schweiz Monatsschr Zahnmed.* 2003;113(9):985–96.
41. Filoche SK, Soma K, Sissons CH. Antimicrobial effects of essential oils in combination with chlorhexidine digluconate. *Oral Microbiol Immunol.* 2005 Aug;20(4):221–5.
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 Feb;105(2): e61–5.
43. Moreira-Neto JJS, Gondim JO, Raddi MSG, Pansani CA. Viability of human fibroblasts in coconut water as a storage medium. *Int Endod J.* 2009 Sep;42(9):827–30.
44. Gopikrishna V, Baweja PS, Venkateshbabu N, Thomas T, Kandaswamy D. Comparison of coconut water, propolis, HBSS, and milk on PDL cell survival. *J Endod.* 2008 May;34(5):587–9.
45. Agarwal P, Nagesh L, Murlikrishnan. Evaluation of the antimicrobial activity of various concentrations of Tulsi (*Ocimum sanctum*) extract against *Streptococcus mutans*: An in vitro study [Internet]. Vol. 21, *Indian Journal of Dental Research.* 2010. p. 357. Available from: <http://dx.doi.org/10.4103/0970-9290.70800>
46. Messier C, Epifano F, Genovese S, Grenier D. Licorice and its potential beneficial effects in common oro-dental diseases. *Oral Dis.* 2012 Jan;18(1):32–9.
47. Panchal V, Gurunathan D, Muralidharan NP. Comparison of antibacterial efficacy of cinnamon extract, neem extract as irrigant and sodium hypochlorite against: A study. *Indian J Dent Res.* 2020 Jan;31(1):124–8.
48. Jakovlev V, Isaac O, Thiemer K, Kunde R. [Pharmacological investigations with compounds of chamomile ii. new investigations on the antiphlogistic effects of (-)-alpha-bisabolol and bisabolol oxides (author's transl)]. *Planta Med.* 1979 Feb;35(2):125–40.
49. Jakovlev V, Isaac O, Flaskamp E. [Pharmacologic studies on chamomile compounds. VI. Studies on the antiphlogistic effect of chamazulene and matricine]. *Planta Med.* 1983 Oct;49(2):67–73.
50. Achterrath-Tuckermann U, Kunde R, Flaskamp E, Isaac O, Thiemer K. [Pharmacological investigations with compounds of chamomile. V. Investigations on the spasmolytic effect of compounds of chamomile and Kamillosan on the isolated guinea pig ileum]. *Planta Med.* 1980 May;39(1):38–50.
51. Website [Internet]. Available from: Janakiram, C., Venkitachalam, R., Fontelo, P., Iafolla, T. J., & Dye, B. A. (2020). Effectiveness of herbal oral care products in reducing dental plaque & gingivitis - a

- systematic review and meta-analysis. *BMC complementary medicine and therapies*, 20(1), 43. <https://doi.org/10.1186/s12906-020-2812-1>
52. See DM, Broumand N, Sahl L, Tilles JG. In vitro effects of echinacea and ginseng on natural killer and antibody-dependent cell cytotoxicity in healthy subjects and chronic fatigue syndrome or acquired immunodeficiency syndrome patients. *Immunopharmacology*. 1997 Jan;35(3):229–35.
53. Modarai M, Silva E, Suter A, Heinrich M, Kortenkamp A. Safety of Herbal Medicinal Products: Echinacea and Selected Alkylamides Do Not Induce CYP3A4 mRNA Expression. *Evid Based Complement Alternat Med*. 2011; 213021.
54. Al-Harbi MM, Qureshi S, Raza M, Ahmed MM, Giangreco AB, Shah AH. Anticarcinogenic Effect of Commiphora molmol on Solid Tumors Induced by Ehrlich Carcinoma Cells in Mice [Internet]. Vol. 40, *Chemotherapy*. 1994. p. 337–47. Available from: <http://dx.doi.org/10.1159/000239216>
55. Dolara P, Luceri C, Ghelardini C, Monserrat C, Aiolfi S, Luceri F, et al. Analgesic effects of myrrh. *Nature*. 1996 Jan 4;379(6560):29.
56. Bradley PR. *British Herbal Compendium: A Handbook of Scientific Information on Widely Used Plant Drugs*. 1992. 409 p.
57. Arnason JT, Mata R, Romeo JT. *Phytochemistry of Medicinal Plants*. Springer Science & Business Media; 2013. 364 p.
58. Huhtanen CN. Inhibition of Clostridium botulinum by Spice Extracts and Aliphatic Alcohols [Internet]. Vol. 43, *Journal of Food Protection*. 1980. p. 195–6. Available from: <http://dx.doi.org/10.4315/0362-028x-43.3.195>
59. Barnes J, Anderson LA, David Phillipson J. *Herbal Medicines*. 2007. 710 p.
60. Barnes J, Anderson LA, Newall CA, Phillipson JD. *Herbal Medicines: A Guide for Healthcare Professionals*. 2002. 530 p.
61. Bisset NG, Wichtl M. *Herbal Drugs and Phytopharmaceuticals: A Handbook for Practice on a Scientific Basis*. 2001. 566 p.
62. European Scientific Cooperative on Phytotherapy. *ESCOP Monographs: The Scientific Foundation for Herbal Medicinal Products*. 2003. 556 p.
63. Johnson-White B, Buquo L, Zeinali M, Ligler FS. Prevention of nonspecific bacterial cell adhesion in immunoassays by use of cranberry juice. *Anal Chem*. 2006 Feb 1;78(3):853–7.
64. Yamanaka A, Kimizuka R, Kato T, Okuda K. Inhibitory effects of cranberry juice on attachment of oral streptococci and biofilm formation. *Oral Microbiol Immunol*. 2004 Jun;19(3):150–4.
65. Prashant GM, Chandu GN, Murulikrishna KS, Shafiulla MD. The effect of mango and neem extract on four organisms causing dental caries: Streptococcus mutans, Streptococcus salivarius, Streptococcus mitis, and Streptococcus sanguis: an in vitro study. *Indian J Dent Res*. 2007 Oct;18(4):148–51.
66. Saini R, Sharma S, Saini S. Ayurveda and herbs in dental health. *Ayu*. 2011 Apr;32(2):285–6.

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