A REVIEW ON PLANT DERIVED PHYTO CHEMICALS IN ORAL HYGIENE

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ABSTRACT

Oral lesions has numerous etiologies, counting viral or bacterial contaminations, neighbourhood injury or disturbance, foundational messes, and surprisingly over the top liquor and tobacco utilization. People information on restorative herbs and phytochemicals in the management of oral mucosal injuries has acquired uncommon consideration among established researchers. This survey was done counselling reports somewhere in the range of 2008 to 2018 of Web of Science, PubMed (Medline), Scopus, Embase, Science Direct, Cochrane Database, and Google Scholar. The picked watchwords are herbal plants, oral mucosa, phytochemical, leukoplakia, oral wellbeing oral and lichen planus. An uncommon accentuation was given to specific plants (e.g., Aloe vera, chamomile, coffee and green tea,) and plant-inferred bio actives (e.g., curcumin, lycopene) with hostile to oral mucosal injury action. At long last, preclinical (in vitro and in vivo) and clinical examinations inspecting both the security and adequacy of therapeutic plants and their determined phytochemicals were likewise painstakingly tended to.

RESEARCH METHODOLOGY

Main focus is to authenticate the use of medicinal plants and their derived bio actives in oral hygiene. The present review was done by consulting Web of Science, PubMed (Medline), Scopus, Embase, Science Direct, Cochrane Database, and Google Scholar (as a search engine) to recover the most updated articles on this topic.

The following keywords will be considered: are herbal plants, oral mucosa, phytochemical, leukoplakia, oral wellbeing oral and lichen planus. All articles are carefully analysed by the authors to measure their strengths and weaknesses, and to select the useful ones for the drive of review, ranking articles published between 2008 to 2018.

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BACKGROUND:

Oral wellbeing is a critical pointer of generally wellbeing, prosperity, and personal satisfaction. The World Health Organization (WHO) characterizes oral wellbeing as "a condition of being liberated from constant facial and mouth torment, oral, throat malignant growth, oral contamination and injuries, periodontal (gum) illness, tooth rot, tooth misfortune, and different sicknesses and issues that limit a singular's ability in gnawing, biting, grinning, talking, and psychosocial prosperity" [1].

There are seven significant oral sicknesses and conditions revealed for a large portion of the oral illness trouble.

1. Dental caries (tooth rot)
2. Periodontal (gum) sicknesses
3. Oral tumours
4. Oral signs of HIV
5. Oro-dental injury
6. Cleft lip and sense of taste
7. Noma

Oral sicknesses influence essentially 3.58 billion individuals around the world, with caries of the super durable teeth being the most widely recognized of all conditions evaluated. Around the world, it is evaluated that 486 million youngsters experience the ill effects of caries of essential teeth, and 2.4 billion individuals experience the ill effects of caries of extremely durable teeth according to concentrate on the Global Burden of Disease Study 2016 [2].

Plant bioactive ascents to a developing pattern in the expanded utilization of "over-the-counter" dental item. These days, there is an immense scope of plant bioactive items and innovation accessible that are self-utilized without speaking with a specialist. The expected utilization of normal item in current dentistry is acquired from plants, creatures, marine creatures, and minerals sources (Figure 1.1). Minerals like alum, sodium bicarbonate, and sodium chloride are generally utilized in dentistry. The utilization of an alum mouth flush day by day repressed caries improvement in youngsters with rot inclined teeth [3]. The immersed saline flush and alum wash showed genuinely critical decreases in salivary S. mutans includes in youngsters [4]. Natural tooth stain was diminished utilizing sodium chloride with vinegar [5]. Sodium bicarbonate goes about as an antiadhering specialist for microbes [6]. Cheddar and cow milk animates salivary emission and builds plaque calcium fixation and assurance from caries [7, 8].

FINDINGS:

Plants have been utilized in dentistry as pain relieving and neighbourhood sedative, as antimicrobial plaque specialists, as sterilizers, brightening specialist, antibacterial, to forestall attachment of microorganisms, antianxiety, and hostile to halitosis. Regularly utilized natural items are Syzygium Aromaticum, Azadirachta indica, Aloe vera, Acacia catechu, propolis and miswak. Plants are likewise utilized in root waterway water system, dentin and pulpal fix,sealer concretes,solvents, normal cancer prevention agents,and capacity medium.

Grouping of plant bio actives based on their uses:

Uses	Source	Parts used	biblography
Antiplaque and Whitening agent,	*Acacia Arabica Aa*	Gum, Chewing stick	[22, 23]
	hybridus L. Amaranthus	Leaf of Spinach	[24]
	Papain	Papain,	[25]
	Pineapple	Extract of Bromelain	[25, 26]
	persica Salvadora	Roots	[25, 27]
	Indica Azadirachta	Mouthwash	[28, 29]
	Aloe vera	Mouthwash	[30]
	Ocimum sanctum	Mouthwash	[31]
	Triphala	Polyherbal Ayurvedic formulation	[39]
	Propolis	Mouthwash	[40]
localanesthetic and analgesic	Roxburgh *Pterocarpus marsupium*	Part of Stem wood	[12]
	Syzygium aromaticum Sa	Part of Flower buds	[13]
	Anacyclus pyrethrum Ap	Part of Root	[17]
Anti- anxiety	Lavender (*LavandulaaM)*	Extract - Volatile oil	[18, 19]
	Citrussinensis and Citrus aurantium	Extract - Volatile oil	[20, 21]
Anti- adhesion activity	*Vaccinium M*	Cranberry juice	[45]
	Polygonum C	extract of Methanol from root	[46]
	Andrographis P,Cassia a, Chinese blacktea and *Harrisonia p*	extract of Ethanol	[47]
	Helichrysum i	tops of Flowering	[48]

	Cinnamomum verum	essential oil of Bark	[54]
	Chenopodium quinoa Willd	Alkali-transformed saponin from quinoa husks	[55]
	Bixa orellana	Seeds	[56]
	Rice bran, sesame	Oil	[57]
	Oregano	Extract solution	[70]
	Probiotic	Mouthwash	[41]
	Calendula officinalis	Tincture	[42]
	Dill	Seed oil	[43]
	Turmeric	Mouthwash	[44]
Pulpal and dentinrepair	*Allium sativum*	Oil	[87]
	Green propolis	Extract	[88]
	Nigella sativa	Oil	[93]
	Tobaco	Nicotine	[94]
	Polyphenols found in variousplants	Epicatechin	[95]
Storage medium	Green tea	Extract	[96]
	Coconut	*Water*	[97]
	Thai propolis	*Extract*	[98]
	Probiotic	Milk	[100]
	Salvia officinalis	extract	[104]

Sealer cements	*Juniperus cedrus, Hiba cedar wood* (*Thujopsis dolabrata*) *and Western red cedar* (*Thujaplicata*)	*Hinokitiol-modified calcium silicate* (*CS*) *cement*	[112]
	Curcuma longa	Curcumin-loaded mesoporous calcium silicate	[113]
Natural antioxidantson the shear bond strength - composite Resin	Green tea and white tea	Extract	[114]
	Aloe Vera, Pomegranate Peel,Grape Seed, Green Tea	Extract	[115]
	Amla (Indian gooseberry)	Extract	[116]
	Grape seed	Extract	[117]
	Rosemary	Extracts	[118]
	Mangosteen	Peel extract	[119]
Solvents	Eucalyptus, orange, clove oil	Oil	[120]
	Grapefruit, lemon	Oils	[121]

S. No	Sources	Phyto-constituents - Active	Activity	References
1.	*Aceriphyllum r*	3-oxoolean-12-en-27-oic acid and Aceriphyllic acid	Anticariogenic activity	[122]
2.	*Albizia m*	Lupinifolin	Anticariogenic activity	[123]
3.	*Allium s*	Allicin, diallyl sulfide	Antimicrobialactivity	[124, 125]
4.	*Bursera m,* Ramirez	γ-terpinene ,A-pinene	Antifungal	[126]
5.	*Cymbopogon n*	Citronellal	Antifungal	[127]
6.	*Dryopteris c*	Linoleic acid	Antibiofilmactivity	[128]
7.	*Diospyros l*	Juglone	Antibacterial	[129]
8.	*Erythrina v*	Erycristagallin	Antibacterialproperty	[130]
9.	*Eucalyptus g*	a, b, and c -Macrocarpals	Antibacterial	[131]
10.	*Garcinia k*/Heckel	Biflavonoid	Antibacterial	[132]
11.	*Gnetum gnemon* L	Resveratrol	Osteoclastactivity	[133]
12.	*Mentha p*	Menthol	Antimicrobial	[134]
13.	*Origanum o*	Thymol and Carvacrol	Antimicrobial	[135]
14.	*Scrophularia s*	, quercetin,apigenin and Gallic acid	Antimicrobial	[136]
15.	*Rumex acetosa* L	Procyanidin-b2-di-gallate	Antimicrobial	[137]
16.	Flavonoids present in many fruits andvegetables	kaemferol and Quercetin	Antimicrobial	[138]
17.	Nidus vespae	Quercetin	Antimicrobial	[139]

Over the most recent couple of many years, different phytochemicals are accounted for in dentistry showing antimicrobial, pain relieving, nearby sedative, against halitosis, and teeth whitening movement. The substance constituents got from normal assets assume a critical part in dentistry field. Phytochemicals like flavones, alkaloids, flavonols, flavonoids, terpenes, phenols, terpenoids, saponins, glycosides, quinone subsidiaries, , phenolic acids, alcohols, aldehydes, lectins, , ketones, amino acids and catalysts, are broadly utilized in oral consideration.

ORAL HYGIENE - CLINICALLY-STUDIED PLANT PRODUCTS

Because of the results of regularly utilized synthetic based dental cleanliness items like toothpastes, mouthwash, and dentifrices, analysts are attempting to discover natural items that don't contain any substance fixings. Purchasers frequently incline toward natural items as opposed to the items that contain substance fixings. As of late, clinical investigations on adequacy and security of plant concentrates and natural determined dental items were expanded to help their use in oral consideration [32]. A portion of the significant clinical investigations are summed up underneath. For instance, Srinivasa et al. once assessed the gingival status and plaque status of kids brushing with monetarily accessible home dentifrices (containing chamomile, sodium monofluo-rophosphate , myrrh, eucalyptus, and wise as dynamic fixings) in comparison with artificial dentifrice (triclosan and sodium monofluorophosphate as dynamic elements) for 21 days. Despite the fact that they tracked down no huge contrast between the two gatherings, the home grown gathering showed a critical decrease in gingival draining and aggravation contrasted with the non-natural gathering. It very well may be a direct result of the mitigating and astringent possessions of the natural ingredients in the home dentrifrice. In this manner, the tried natural dentifrice can be considered as an elective item to ensure gingival wellbeing contrasted and the business one [33].

Notwithstanding their impact on dental wellbeing, smell, taste, and the other physiognomies of the home dental items, which are vital for the customer or patients to utilize it elegantly. The anti-microbial impact of Melaleuca a (tea tree) comprising dental gel was been concentrated in 54 orthodontic patients the business and contrasted toothpaste Colgate Total. While Melaleuca gel was been observed to be more convincing in lessening the quantity of bacterial settlements, and dental biofilm and was not been as great as Colgate Total with respect to the smell, taste, and the other character potentials. They have found that Melaleuca gel is proficient in the limiting of development of bacterial yet demands great definition for development in first sensation and taste [34].

Gum disease and Plaque decrease were surveyed with the toothpaste comprising Azadirahta I (neem) and the business toothpaste closely in randomized, twofold visually impaired clinical preliminary. In this investigation, standard utilization of neem- comprising toothpaste has given a significant decrease in development of plaque and had worked on the gingival wellbeing of the members. It could be because of the calming impacts of neem and antibacterial effect. This outcome indicated, ordinary brushing with the help of neem toothpaste is significant for the maintenance of good oral cleanliness and enhancement of oral wellbeing [35]. Also, the impact of mango mouthwashes and neem on oral wellbeing had been evaluated by Sharma et al. [26].

As of late, impressive investigates have been led on business mouth rinses and toothpastes containing natural concentrates. Business natural toothpaste Paradontax, possess sodium fluoride, sodium bicarbonate, and home dentrifices including echinacea, chamomile, myrrh,

sage, peppermint oil and rhatany, which had been assessed in a twofold visually impaired clinical preliminary for limiting of gum disease and plaque. It had been discovered that Paradontax couldn't illustrate critical clinical benefit than the regular toothpaste containing fluoride. These outcome showed that the business natural toothpastes ought to be evaluated appropriately for their adequacy and benefit contrasting the traditional toothpastes [37].

Likewise, the adequacy of Paradontax had been additionally assessed for the decrease of plaque and gum disease in contrast with the dentifrice with fluoride and triclosan for 28 days. While a huge decrease had been seen in plaque arrangement and gum disease between the two gatherings, and no huge distinction had been found between two gatherings. The creators inferred that both toothpastes had been powerful in diminishing gingivitis and dental plaque [38]. The mitigating impact of Paradontax had been evaluated nearly with the help of Colgate natural toothpaste, which contains chamomile, calcium carbonate, myrrh, sage, sodium monoflurophosphate and eucalyptus, in gingival and plaque aggravation. In these examination, the two plans decreased plaque development levels and gingival aggravation. Be that as it may, Paradontax didn't show any extra advantages than Colgate natural toothpaste [39].

In the other investigation, dental cream from ayurvedic has been assessed in contrast with dental cream containing fluoride for viability and security in randomized twofold visually impaired examination. Natural cream in dentistry comprises of various plant species of ayurvedic origin, for example, powders of Vaikranta bhasma, Azadirachta indica and Ajamoda satva, and concentrates of Punica granatum, Zanthoxylum alatum, Acacia arabica, Vitex negundo, and Triphala and Embelia ribes. However huge insurance was seen in the two gatherings, their viability is essentially not the same as one another. As per this outcome, the dental cream from Ayurveda is pretty much as protected and successful as that of dental cream containing fluoride, yet isn't better than the avoidance and the executives of dental plaque development [40]. The other ayurvedic toothpaste containing home dentrifices, for example, the concentrates of Adhatoda vasica, Acacia chundra, Piper nigrum, Mimusops elengi, Quercus infectoria, Pongamia pin-nata, Terminalia chebula, Zingiber officinale and Syzygium aromaticum, had been tried for its viability for working on gingival wellbeing, oral cleanliness, and salivary microbial greenery. They discovered measurably huge decreases on salivary anaerobic bacterial counts, better oral cleanliness and gingival dying, while the fake treatment bunch didn't show any critical enhancement in oral ailment [7].

Licorice is one of the significant customary spices utilized for various physiological conditions and as a food fixing all through the world. These impact of various licorice prep-proportions on dental issues was assessed by various creators. Ongoing explores recommend that licorice concentrates and there phytochemicals had valuable impacts in oral cleanliness and oral infections. These impacts had been credited to the antimicrobial, antiadherence and mitigating properties of its components. In glycyrrhizin, that has been one of the significant parts of licorice, had been changed over to glycyrrhetic corrosive in humans and can prompt extreme hypokalaemia and hypertension in the body. Consequently, licorice separate without glycyrrhizin ought to be liked for the use to forestall the results of licorice [46, 47]. In vitro studies have exhibited the capability of licorice and profile dynamic components to treat oral infection. Then again, clinical preliminaries have commonly conflicting outcomes. In this way, oral cleanliness items containing root of licorice concentrates and components should have been further investigated.

ORAL HYGIENE - IN VITRO-STUDIED HERBAL PRODUCTS

Tested herbal product	Method	Result	Conclusion	Phytochemicals	Ref
Populusnigra, P. lasiocarpa,P. x berolinensis, Leaf-bud extracts	Anti-inflammatory activity-gingival fibroblasts	berolinensis effective	Useful in the treatment of gingivitis, for oral hygiene and periodontitis	Flavanons: pinocembin, pinostrobin	[52]
essential oil *of Artemisia sieberi*	Antimicrobial activity against yeast, fungi and Gram +/− bacteria,	Active	Because of antibacterial effectagainst *S. mutans* it can be used in toothpastes	camphor thujone,	[28]
Dried extract of bark of *AcaciaArabica* *fruits of Terminalia chebula*, fruits of *Terminalia bellerica,* fruits of *Emblica officinalis,*	biofilm disruption, anticaries and Antimicrobial effect against cariogenic bacteria	Inhibitory effects of cariogenic microorganisms and *S. mutants* biofilm formation	anticariogenic dentalproducts		[23]
Combination of green tea and *Salvadora persica* extracts	Effect on dental biofilm formation	Synergistic antibacterial and antiadherence effects	Useful active agent fororal care products.	Green tea: catechins and flavonoids; *S. persica:* trimethylamine, salvadorine, thiocyanate, tannins, nitrate.	[14]

Pistacia vera oleoresin	Antimicrobial properties	reducing the ability to form biofilm and Strong anti-virulence effect against *S. mutans*	*P. vera* oleoresin can be used in oral hygiene products	Oleoresin, -pinen, triterpenes	[53]
95% ethanol extract of *Piper betle* with 3 different commercial toothpastes	Antimicrobial Effect against *Staphylococcus aureus*, *Escherichia coli, Streptococcus salivarius*, *S. mutans and Candida albicans*	Toothpaste- than those exhibited by the toothpastes alone, *P. betle* extract combinations is more effective	It can be used as effective toothpaste ingredients	Phenolics	[54]
extract of Deglycyrrhizinated licorice	Antimicrobial activity against *Streptococcus mutans and* biofilm formation		16 mg/mL of extract is useful in the development of oral hygiene products	Phenolics	[47]

PUBLIC HEALTH SIGNIFICANCE:

The ebb and flow worldwide requirement of some elective treatment and anticipation alternatives for oral illnesses that were safe, powerful, and conservative is because of expansion in occurrence of sicknesses, rise of antimicrobial obstruction microbes, pioneering contaminations in invulnerable compromised people, and monetary weight (Khan et al. 2017). Albeit numerous specialists are as a rule industrially utilized for management of oral microbiota, their unfortunate incidental effects will make them less fruitful in security angles (Fair and Tor 2014). A portion of compound antibacterial specialists, for example, chlorhexidine, cetylpyridinium chloride, and amine fluorides have displayed some sort of harmfulness with the staining of teeth, prompting oral malignant growth.

Subsequently, quest for elective substances is in incredible interest and bioactive accumulates from plants were being utilized in customary medications as corresponding medication. Restorative spices are acquiring significance and home grown renaissance is noticed from one side of the planet to the other. The spices and their items are representing wellbeing rather than the engineered medication, which were considered as dangerous to both climate and people. Spices containing therapeutic properties are a significant and viable hotspot for treatment of different sicknesses (Petrovska 2012). These natural concentrates have been reliably utilized in keeping up with oral wellbeing by tooth cleaning and as antimicrobial plaque specialists

CONCLUSION:

The information recommend leads for developing new medications and oral cleanliness items from normal sources. A few normal regular items are utilized to work on oral wellbeing: raisins, rhein, chamomile, pomegranate, fundamental oils, nectar, probiotics, green tea, mushrooms, and biting sticks. Some dynamic compound standards have been detached from therapeutic plants utilized against oral microbes. Along these lines, regarding normal items for oral wellbeing, there is an earnest need to expand research endeavors and subsidizing pointed toward distinguishing more regular items that have antimicrobial viability focusing on oral microbes. More investigations ought to likewise zero in on toxicological security of normal items, clinical preliminaries on viability and wellbeing, disengagement and characterisation of dynamic synthetic mixtures. Mouth is a bustling place for protozoal parasites and microorganisms. Numerous oral organisms had become progressively pathogenic over the span of HIV contamination. Thus, oral contaminations are becoming powerful and genuine astute infections related with AIDS. Oral sicknesses ought to accordingly be a vital part of flow HIV/AIDS exploration and intercessions.

BIBLOGRAPHY:

1. van der Weijden, F. and Slot, D.E., Oral hygiene in the prevention of periodontal diseases: The evidence. Periodontol. 2000, 55, 104–23, 2011.

2. Müller, F., Shimazaki, Y., Kahabuka, F., Schimmel, M., Oral health for an ageing population: The importance of a natural dentition in older adults. Int. Dent. J., 2, 7–13, 2017.

3. Bodiba, D., Szuman, K.M., Lall, N., The Role of Medicinal Plants in Oral Care, Medicinal Plants for Holistic Health and Well-Being, Lall, N. (Ed.), Elsevier, pp. 183–222, 2018.

4. Farrimond, B. and Oral Hygiene & Nursing Care, CNS for Head & Neck Oncology, 2008.

5. Abbate, J. and Guynup, S., Oral health goes modern. J. Sci. Am., 19, 4–5, 2016.

6. Rajagopalan, A., Herbal Products in Oral Hygiene Maintenance—A Review. IOSR J. Pharm., 5, 48–51, 2015.

7. Jayashankar, S., Panagoda, G.I., Amaratunga, E.A., A randomised double-blind placebo- controlled study on the effects of a herbal toothpaste on gingival bleeding, oral hygiene and microbial variables. Ceylon Med. J., 56, 5–9, 2011.

8. Aumeeruddya, M.Z., Zengin, G., Mahomoodally, M.F., A review of the traditional and modern uses of Salvadorapersica L. (Miswak): Toothbrush tree of Prophet Muhammad. J. Ethnopharmacol., 213, 409–444, 2018.9. Wu, C.D. and Savitt, E.D., Evaluation of the safety and efficacy of over-the-counter oral hygiene products for the reduction and control of plaque and gingivitis. Periodontol, 28, 91–105, 2002.

10. Rosan, B. and Lamont, R.J., Dental plaque formation. Microbes Infect, 2, 1599–1607, 2000.

11. Lertpimonchai, A., Rattanasiri, S., Vallibhakara, S.A., Attia, J., Thakkinstian, A., The association between oral hygiene and periodontitis: A systematic review and meta-analysis. Int. Dent. J., 67, 332–343, 2017.

12. Addy, M. and Moran, J.M., Evaluation of oral hygiene products: Science is true; don't be misled by the facts. Periodontol. 2000, 15, 40–51, 1997.

13. Laing, E., Ashley, P., Gill, D., Naini, F., An update on oral hygiene products and techniques.Dent. Update, 35, 270–279, 2008.

14. Abdulbaqi, H.R., Himratul-Aznita, W.H., Baharuddin, N.A., Anti-plaque effect of asynergistic combination of green tea and Salvadorapersica L. against primary colonizers of dental plaque. Arch. Oral Biol., 70, 117–124, 2016.

15. Choo, A., Delac, D.M., Messer, L.B., Oral hygiene measures and promotion: Review and con-siderations. Aust. Dent. J., 46, 166–73, 2001.

16. Palombo, E.A., Traditional Medicinal Plant Extracts and Natural Products with Activity against Oral Bacteria: Potential Application in the Prevention and Treatment of Oral

Diseases. Evid. Based Complement. Alternat. Med. eCAM, 10, 1–15, 2011.

17. Moran, J.M., Home-use oral hygiene products: Mouthrinses. Periodontol. 2000, 48, 42–53, 2008.

18. Teh, J.Y., Rawi, R., Noor, S.S., Taib, H., Mohamad, S., In-vitro antimicrobial effectiveness of herbal-based mouthrinses against oral microorganisms. Asian Pac. J. Trop. Biomed., 5, 370– 374, 2015.

19. Ahmad, H. and Rajagopal, K., Salvadorapersica L. (meswak) in dental hygiene. Saudi J. Oral Dent. Res., 5, 130–134, 2014.

20. Aboul-Enein, B.H., The miswak (Salvadorapersica L.) chewing stick: Cultural implications in oral health promotion. Saudi J. Oral Dent. Res., 5, 9–13, 2014.

21. Abdel-Kader, M.S., Khamis, E.H., Foudah, A.I., Alqarni, M.H., GC quantitative analysis of benzyl isothiocyanate in Salvadorapersica roots extract and dental care herbal products. Saudi Pharm. J., 26, 462–466, 2018.

22. Goenka, P., Sarawgi, A., Karun, V., Nigam, A.G., Dutta, S., Marwah, N., Camellia sinensis (tea): Implications and role in preventing dental decay. Pharmacogn. Rev., 7, 152–156, 2013.

23. Ramalingam, K. and Bennett, T.A., Antimicrobial effect of herbal extract of Acacia arabica with triphala on the biofilm forming cariogenic microorganisms. J. Ayurveda Integr. Med., 2018, https://doi.org/10.1016/S2221-1691 (12)60353-0.

24. Rasingam, L., Jeeva, S., Kannan, D., Dental care of Andaman and Nicobar folks: Medicinal plants use as tooth stick. Asian Pac. J. Trop. Biomed., 2, 1013–1016, 2012.

25. Swetha, I., Vishnu Priya, V., Gayathri, R., Benefits of herbal medicine in oral care. Drug Invent. Today, 10, 1084–1087, 2018.

26. Sharma, R., Hebbal, M., Ankola, A.V., Murugaboopathy, V., Shetty, S.J., Effect of Two Herbal Mouthwashes on Gingival Health of School Children. J. Tradit. Complement. Med., 1, 272–278, 2014.

27.Prashant, G.M., Chandu, G.N., Murulikrishna, K.S., Shafiulla, M.D., The effect of mango and neem extract on four organisms causing dental caries: Streptococcus mutans,

Streptococcus salivavius, Streptococcus mitis, and Streptococcus sanguis: An in vitro study. Indian J. Dent. Res., 18, 148–51, 2007.

28. Mahboubi, M. and Farzin, N., Antimicrobial activity of Artemisia sieberi essential oil from cen- tral Iran. Iran J. Microbiol., 1, 43–48, 2009.

29. Amanullah, M., Sadatullah, S., Yaseen, S.M., Dawasaz, A.A., Use of herbal extract from Artemisia herba-alba (Shih) in pharmaceutical preparations for dental hygiene. Saudi Pharm. J., 26, 822–828, 2018.

30. Singh, A. and Purohit, B., Tooth brushing, oil pulling and tissue regeneration: A review of holis- tic approaches to oral health. J. Ayurveda Integr. Med., 2, 64–68, 2012.

31. Shanbhag, V.K.L., Oil pulling for maintaining oral hygiene – A review. J. Tradit. Complement. Med., 7, 106–109, 2017.

32.Khairnar, M.R., Dodamani, A.S., Karibasappa, G.N., Naik, R.G., Deshmukh, M.A., Efficacy of herbal toothpastes on salivary pH and salivary glucose, A preliminary study. J-AIM, 8, 3–6, 2017.

33.Srinivasa, S., Nandlal, B., Srilatha, K.T., A comparative evaluation of a commercially available herbal and non-herbal dentifrice on dental plaque and gingivitis in children—A residential school-based oral health programme. J. Dent. Oral Hyg., 3, 109–113, 2011.

34.Santamaria, M., Petermann, K.D., Vedovello, S.A., Degan, V., Lucato, A., Franzini, C.M., Antimicrobial effect of Melaleuca alternifolia dental gel in orthodontic patients. Am. J. Orthod. Dentofacial Orthop., 145, 198–202, 2014.

35. Abhishek, K.N., Supreetha, S., Sam, G., Khan, S.N., Chaithanya, K.H., Abdul, N., Effect of neem containing toothpaste on plaque and gingivitis—A randomized double blind clinical trial. J. Contemp. Dent. Pract., 16, 880–883, 2015.

36.Adámková, H., Vičar, J., Palasová, J., Ulrichová, J., Šimánek, V., Macleya cordata and Prunella vulgaris in oral hygiene products—Their efficacy in the control of gingivitis. Biomed. Pap., 148, 103–105, 2004.

37.Pannuti, C.M., Mattos, J.P., Ranoya, P.N., Jesus, A.M., Lotufo, R.F., Romito, G.A., Clinical effect of herbal dentifrice on the control of plaque and gingivitis: A double-blind study. Pesqui. Odontol. Bras., 17, 314–318, 2003.

38.Ozaki, F., Pannuti, C.M., Imbronito, A.V., Pessotti, W., Saraiva, L., de Freitas, N.M., Ferrari, G., Cabral, V.N., Efficacy of a herbal toothpaste on patients with established gingivitis—A random- ized controlled trial. Braz. Oral Res., 20, 172–177, 2006.

39.Hosadurga, R., Boloor, V.A., Rao, S.N., MeghRani, N., Effectiveness of two different herbal toothpaste formulations in the reduction of plaque and gingival inflammation in patients with established gingivitis—A randomized controlled trial. J. Tradit. Complement. Med., 9, 113–119, 2018.

40.Amrutesh, S., Malini, J., Tandur, P.S., Patki, P., Clinical evaluation of a novel herbal dental cream in plaque formation: A double-blind, randomized, controlled clinical trial. J. Exp. Pharmacol., 2, 105–109, 2010.

41.Gazi, M.I., Lambourne, A., Chgla, A.H., The antiplaque effect of tooth paste containing Salvadorapersica compared with chlorhexidine gluconate. Clin. Prev. Dent., 9, 3–8, 2008.

42.Rahmani, M.E. and Radvar, M., The anti-plaque activity of Salvadorapersica and padina essen- tial oil solution in comparison to chlorhexidine in human gingival disease: A randomized placebo-controlled clinical trial. Int. J. Pharmacol., 1, 311–315, 2005.

43.Singh, A., Daing, A., Dixit, J., The effect of herbal, essential oil and chlorhexidine mouthrinse on de novo plaque formation. Int. J. Dent. Hyg., 11, 48–52, 2013.

44.Southern, E.N., McCombs, G.B., Tolle, S.L., Marinak, K., The comparative effects of 0.12% chlorhexidine and herbal oral rinse on dental plaque-induced gingivitis. J. Dent. Hyg., 80, 1–9, 2006.

45. Messier, C., Epifano, F., Genovese, S., Grenier, D., Licorice and its potential beneficial effects in common oro-dental diseases. Oral Dis., 18, 32–39, 2012.

46.Ahn, S.J., Park, S.N., Lee, Y.J., Cho, E.J., Lim, Y.K., Li, X.M., Choi, M.H., Seo, Y.W., Kook, J., In vitro

antimicrobial activities of 1-methoxyficifolinol, licorisoflavan A, and 6,8-diprenyl- genistein against Streptococcus mutans. Caries Res., 49, 78–89, 2015.

47. Mentes, J.C., Kang, S., Spackman, S., Bauer, J., Can a licorice lollipop decrease cariogenic bac- teria in nursing home residents? Res. Gerontol. Nurs., 5, 233–237, 2012.

48.Hu, C.H., He, J., Eckert, R., Wu, X.Y., Li, L.N., Tian, Y., Lux, R., Shuffer, J.A., Gelman, F., J., Mentes Development and evaluation of a safe and effective sugar-free herbal lollipop that kills cavity causing bacteria. Int. J. Oral Sci., 3, 13–20, 2011.

49. Khalessi, A.M., Pack, A.R., Thomson, W.M., Tompkins, G.R., An in vivo study of the plaque control efficacy of Persica: A commercially available herbal mouthwash containing extracts of Salvadorapersica. Int. Dent. J., 54, 279–283, 2004.

50. Poureslami, H., The Effects of Plant Extracts on Dental Plaque and Caries, in: Contemporary Approach to Dental Caries, M.-Y. Li (Ed.), IntechOpen, pp. 395–402, 2012.

51. Sidhu, P., Shankargouda, S., Rath, A., Ramamurthy, P.H., Fernandes, B., Singh, A.K., Therapeutic benefits of liquorice in dentistry. J. Ayurveda Integr. Med., 2018, https: //doi.org/10.1016/j. jaim.2017.12.004.

52. Pobłocka-Olech, L., Inkielewicz-Stepniak, I., Krauze-Baranowska, M., Anti-inflammatory and antioxidative effects of the buds from different species of Populus in human gingival fibroblast cells: Role of bioflavanones. Phytomedicine, 15, 1–9, 2019.

53.Magi, G., Marini, E., Brenciani, A., Di Lodovico, S., Gentile, D., G., Ruberto, Cellini, L., Facielli, B., Napoli, E., Chemical composition of Pistaciavera L. oleoresin and its antibacte- rial, anti-virulence and anti-biofilm activities against oral streptococci, including Streptococcus mutans. Arch. Oral Biol., 96, 208–215, 2018.

54. Goldstein, B.H. and Epstein, J.B., Unconventional dentistry: Part IV. Unconventional dental practices and products. J. Can. Dent. Assoc., 66, 564–568, 2000.

55. Eid, M.A. and Talic, Y.F., A clinical trial on the effectiveness of professional toothbrushing using

dentifrice and water. Odontostomatol. Trop., 14, 9–12, 1991.

56. Fischman, S.L., The history of oral hygiene products: How far have we come in 6000 years? Periodontol. 2000, 15, 7–14, 1997.

56. Binney, A., Addy, M., Newcombe, G., The plaque removal effects of single rinsing and brush- ings. J. Periodontol., 64, 181–185, 1993.

57. Van Der Veijden, F. and Slot, D.E., Oral hygiene in the prevention of periodontal diseases: The evidence. Periodontol. 2000, 55, 104–123, 2011.

58. Ahmed, J., Shenoy, N., Binnal, A., Mallya, L.P., Shenoy, A., Herbal oral care: An old concept or a new model? Int. J. Res. Med. Sci., 2, 818–821, 2014.

59. Srinivasan, K. and Chitra, S., Holistic Dentistry: Natural approaches to Oral Health. Sch. Bull., 1, 267–270, 2015.

60. Petersen, P.E., and The World Oral Health Report 2003: Continuous improvement of oral health in the 21st century: The approach of the WHO Global Oral Health Programme. Community Dent. Oral Epidemiology, 31, Suppl 1, 3–23, 2003. [PubMed: 15015736].

61. Benjamin, R.M., Oral health: The silent epidemic. Public Health Rep., 125, 2, 158–159, 2010.

62. Shewale, A.H., Gattani, D.R., Bhatia, N., Mahajan, R., Saravanan, S.P., Prevalence of Periodontal Disease in the General Population of India—A Systematic Review. J. Clin. Diagn. Res., 10, 6, ZE04–09, PMID: 27504431, 2016.

63. Kundu, D., Mehta, R., Rozra, S., Periodontal status of a given population of West Bengal: An epidemiological study. J. Indian Soc. Periodontol., 15, 2, 126–129, 2011.

64. Laine, M.L., Crielaard, W., Loos, B.G., Genetic susceptibility to periodontitis. Periodontol. 2000, 58, 37–68, 2012.

65.Malhotra, R., Grover, V., Kapoor, A., Saxena, D., Comparison of the effectiveness of a commer- cially available herbal mouthrinse with chlorhexidine gluconate at the clinical and patient level. J. Indian Soc. Periodontol., 15, 4, 349–352, 2011.

66. Kaur, H., Jain, S., Kaur, A., Comparative evaluation of the anti-plaque effectiveness of green tea

catechin mouthwash with chlorhexidine gluconate. J. Indian Soc. Periodontol., 18, 178–182, 2014.

67. Ahmed, S., Anuutiyo, J., Malimud, C.J., Haqqi, T.M., Biological basis for the use of botanicals in osteoarthritis and rheumatoid arthritis: A review. Evid. Based Complement. Alternat. Med., 2, 301–308, 2005.

68. World Health Organization, Traditional Medicine, Geneva: World Health Organization (WHO), 2008 [Last Accessed date 2019 Feb 01]. Available from: http://www.who.int/medicines/areas/traditional/en/.

69. Allafi, T. and Ababneh, H., The effect of extract of miswak (chewing sticks) used in Jordan and the Middle East on oral bacteria. Int. Dent. J., 45, 218–222, 1995.

70.Naik, G.H., Priyadarsini, K.I., Satav, J.G., Banavalikar, M.M., Sohoni, D.P., Biyani, M.K. et al., Comparative antioxidant activity of individual herbal components used in Ayurvedic medi- cine. Phytochemistry, 63, 97–104, 2003.

71. Telles, S., Naveen, K.V., Balkrishna, A., Use of Ayurveda in promoting dental health and preventing dental caries. Indian J. Dent. Res., 20, 2, 246, 2009.

72. Venugopal, T., Kulkarni, V.S., Nerurker, R.A., Damle, S.G., Patnekar, P.N., Epidemiological study of dental caries. Indian J. Pediatr., 65, 6, 883–889, 1998.

73. Muhammad, S.A. and Muhammad, A., Significance of chewing sticks (miswak) in oral hygiene from a pharmacological view point. J. Pak. Med. Assoc., 11, 89–95, 1981.

74. Al-Otaibi, M., Al-Harthy, M., Soder, B., Gustafsson, A., Angmar-Mansson, B., Comparative effect of chewing sticks and toothbrushing on plaque removal and gingival health. Oral Health Prev. Dent., 1, 4, 301–307, 2003

75. Almas, K., Al-Zeid, Z., The immediate antimicrobial effect of a toothbrush and miswak on cariogenic bacteria: A clinical study. J. Contemp. Dent. Pract., 5, 1, 105–14, 2004.

76. Kadam, A., Prasad, B.S., Bagadia, D., Hiremath, V.R., Effect of Ayurvedic herbs on control of plaque and gingivitis: A randomized controlled trial. Ayu, 32, 532–535, 2011. [PMCID: PMC3361930] [PubMed: 22661849].

77. Hebbar, A., Keuskar, V., Shetti, A., Oil pulling: Unravelling the path to mystic cure. J. Int. Oral Health, 2, 11–14, 2010.

78. D'Aiuto, F., Nibali, L., Parkar, M., Patel, K., Suvan, J., Donos, N., Oxidative stress, systemic inflammation, and severe periodontitis. J. Dent. Res., 89, 1241–1246, 2010.

79.Devasagayam, T.P., Tilak, J.C., Boloor, K.K., Sane, K.S., Ghaskadbi, S.S., Lele, R.D., Free radicals and antioxidants in human health: Current status and future prospects. J. Assoc. Physicians India, 52, 794–804, 2004

80. Lean, J.M., Jagger, C.J., Kirstein, B., Fuller, K., Chambers, T.J., Hydrogen peroxide is essential for estrogen-deficiency bone loss and osteoclast formation. Endocrinology, 146, 728–735, 2005.

81. Giannopoulou, C., Krause, K.H., Müller, F., the NADPH oxidase NOX2 plays a role in peri- odontal pathologies. Semin. Immunopathol, 30, 273–278, 2008.

82. Shirzaiy, M., Ansari, S.M., Dehghan, J.H., Ghaeni, S.H., Total anti-oxidant capacity of saliva in chronic periodontitis patients before and after periodontal treatment. J. Nepal Health Res. Counc., 12, 172–176, 2014.

83. Cabrera, C., Artacho, R., Giménez, R., Beneficial effects of green tea – A review. J. Am. Coll. Nutr., 25, 79–99, 2006.

84. Sharma, S., Bhuyan, L., Ramachandra, S., Sharma, S., Dash, K.C., Dhull, K.S., Effects of green tea on periodontal health: A prospective clinical study. J. Int. Oral Health, 9, 39–44, 2017.

85.Asahi, Y., Noiri, Y., Miura, J., Maezono, H., Yamaguchi, M., Yamamoto, R. et al., Effects of the tea catechin epigallocatechin gallate on Porphyromonas gingivalis biofilms. J. Appl. Microbiol., 116, 1164–1171, 2014.

86. Araghizadeh, A., Kohanteb, J., Fani, M.M., Inhibitory activity of green tea (Camellia sinensis) extract on some clinically isolated cariogenic and periodontopathic bacteria. Med. Princ. Pract., 22, 368–372, 2013.

87. Okamoto, M., Leung, K.P., Ansai, T., Sugimoto, A., Maeda, N., Inhibitory effects of green tea catechins on protein tyrosine phosphatase in Prevotella intermedia.

Oral Microbiol. Immunol., 18, 192–195, 2003.

88. Tominari, T., Matsumoto, C., Watanabe, K., Hirata, M., Grundler, F.M., Miyaura, C. et al., Epigallocatechin gallate (EGCG) suppresses lipopolysaccharide-induced inflammatory bone resorption, and protects against alveolar bone loss in mice. FEBS Open Bio. 5, 522–227, 2015.

89. Hrishi, T., Kundapur, P., Naha, A., Thomas, B., Kamath, S., Bhat, G., Effect of adjunctive use of green tea dentifrice in periodontitis patients – A randomized controlled pilot study. Int. J. Dent. Hyg., 14, 3, 178–183, 2016.

90. Hirasawa, M., Takada, K., Makimura, M., Otake, S., Improvement of periodontal status by green tea catechin using a local delivery system: A clinical pilot study. J. Periodontal. Res., 37, 433–438, 2002.

91. Kaur, H., Jain, S., Kaur, A., Comparative evaluation of the antiplaque effectiveness of green tea catechin mouthwash with chlorhexidine gluconate. J. Indian Soc. Periodontol., 18, 178–82, 2014.

92. Chang, B., Hung, C.T., Chiu, W., Herbal medicine and anesthesia. Hong Kong Med. J., 8, 123– 130, 2002.

93. PDR for herbal medicines, 2nd ed., p. 776, Medical Economics Company, Montvale. NJ, 2000.

94. Chaturvedi, T.P., Uses of turmeric in dentistry: An update. Indian J. Dent. Res., 20, 107–109, 2009.

95. Yokozawa, T., Kim, H.Y., Kim, H.J., Tanaka, T., Sugino, H., Okubo, T. et al., Amla (Emblica officinalis) attenuates age-related renal dysfunction by oxidative stress. J. Agric. Food Chem., 55, 7744–7752, 2007.

96.Nadkarni, K.M. and Nadkarni, A.K., Vegetable kingdom, in: Indian Materia Medica with Ayurvedic, Unani- Tibbi, Siddha, Allopathic, Homeopathic, Naturopathic and Home remedies, 3rd ed, vol. 1, K. Nadkarni (Ed.), p. 46, Popular Prakashan Private Ltd., Bombay, India, 1999.

97.Aparecida Procópio Gomes, L., Alves Figueiredo, L.M., Luiza do Rosário Palma, A., Corrêa Geraldo, B.M., Isler Castro, K.C., Ruano de Oliveira Fugisaki, L. et al., Punica

granatum L. (Pomegranate) Extract: In Vivo Study of Antimicrobial Activity against Porphyromonas gingi- valis in Galleria mellonella Model. ScientificWorldJournal, 2016, 8626987, 1–5, 2016.

98. Menezes, S.M., Cordeiro, L.N., Viana, G.S., Punica granatum (pomegranate) extract is active against dental plaque. J. Herb. Pharmacother., 6, 79–92, 2006.

99. DiSilvestro, R.A., DiSilvestro, D.J., DiSilvestro, D.J., Pomegranate extract mouth rinsing effects on saliva measures relevant to gingivitis risk. Phytother. Res., 23, 8, 1123–1127, 2009.

100. Prasad, D. and Kunnaiah, R., Punica granatum: A review on its potential role in treating peri- odontal disease. J. Indian Soc. Periodontol., 18, 4, 428–432, 2014.