



## Herbal Therapy in Periodontics: A Review

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**ABSTRACT:** Herbal medicine, also known as herbalism or botanical medicine, is a medical system based on the use of plants or plant extracts that may be eaten or applied to the skin. Since ancient times, herbal medicine has been used by many different cultures throughout the world to treat illness and to assist bodily functions. Herbal preparations can be derived from the root, leaves, seeds, and flowers. The preparations often contain a concoction of chemical substances may contain minerals and vitamins, and determining a specific active ingredient. Gingivitis is the mild form whereas periodontitis results in an irreversible loss of supporting structures of the teeth. Even though periodontal pathogens form a crucial component in the etiopathogenesis of periodontitis, there is a growing body of evidence suggesting oxidative stress playing a pivotal role in the disease initiation and progression.

This review briefly describes the various herbs and organic substances which are easily available and can aid in quick relief from disease affecting the periodontium.

**Keywords:** Herbal, periodontitis, therapy, dentistry

### I. INTRODUCTION

Herbal medicines, including herbs, herbal preparations and finished herbal products, contain as active ingredients parts of plants or other plant materials perceived to have therapeutic benefits.<sup>1</sup> We have always heard our grandmothers and elderly women talking about their secret concoctions to heal many ailments. It's true that these remedies have been practiced among the Sumerians, the Babylonians and the Assyrians which included gingival massages combined with various herbal medications for tooth related diseases.<sup>2</sup> In fact, About 80% of the worldwide population use herbal products for their basic health care (primary care) such as extracts, teas and other active principles, a market estimated at US\$ 50 billion per year.<sup>3</sup> Herbal products are preferred over conventional drugs due to wide biological activity, higher safety margin, and lower costs. Furthermore, the conventional drugs are known to cause various side effects, and continuous intake has resulted in antibiotic resistance. Thus, herbal medicines are being used increasingly as dietary supplements to fight or prevent common diseases including those affecting our oral cavity.

The periodontium consists of the investing and supporting tissues of the tooth, PDL, cementum and alveolar bone. The gingiva protects the underlying tissue and attachment apparatus. Periodontium is subject to morphological and functional variations as well as changes associated with age.<sup>4</sup>

Gingival and periodontal diseases have afflicted humans since the dawn of history. Studies in paleopathology have indicated that destructive periodontal disease as evidence by bone loss which affected early humans in diverse cultures. Among the ancient Greeks, Hippocrates of Cos (460-377 B.C.) believed that inflammation of gum could be caused by accumulation of 'pituita' or calculus with gingival haemorrhage.<sup>5</sup>

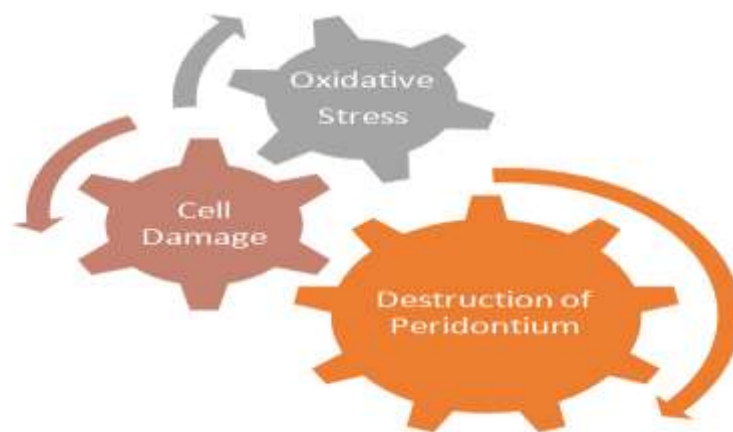
Gingivitis is characterized by the presence of clinical signs of inflammation associated with dental plaque formation, which is the most common type. It may be confined to the gingiva and associated with teeth showing no attachment loss. It can also be as a result of systemic factors, medication or non-plaque induced factors (bacteria, virus etc.) which may or may cause loss of attachment.<sup>6</sup>

Periodontitis is a chronic inflammatory disease which results in the destruction of supporting structures of the teeth. The etiology is multifactorial with periodontopathogens forming a major crux in the initiation and progression of the disease.<sup>7</sup> In simpler terms, formerly known as pyorrhea, periodontitis is an advanced stage of gum disease in which the gums and bones that provide support to the teeth become inflamed and infected.

Periodontal therapy includes both surgical and nonsurgical management of the disease process. Various antimicrobials and chemotherapeutic agents, such as chlorhexidine, triclosan, cetylpyridinium chloride, have

been tried and tested in the management of periodontal diseases. Due to its multifactorial etiology and complex disease process, the treatment of periodontitis is still a formidable task to dentists.<sup>8</sup> Therefore, herbal remedies have been sought to achieve antimicrobial, antioxidant, antiseptic, anti-inflammatory, and anti-collagenase effects.

The onset of periodontal diseases is a multifactorial process. Although, it is well-established that oxidative stress is an important cause of cell damage associated with the initiation and progression of many chronic diseases.<sup>9,10,11</sup>



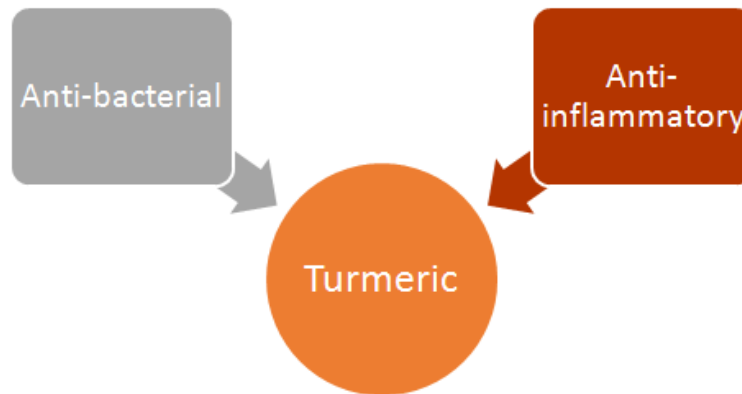
Oxidative stress is the disturbance in the pro-oxidant and antioxidant balance, resulting in potential tissue damage. Plaque build-up allows the growth of anaerobic bacteria, which eventually leads to the recruitment and activation of neutrophils. This further results in the up regulation of pro-inflammatory cytokines and also leads to the release of neutrophilic enzymes and ROS (Reactive Oxygen Species).<sup>12</sup> Prolonged exposure of the connective tissue to these insults results in the degradation and subsequent loss of ligamentous support and alveolar bone( due to formation of osteoclasts by ROS), eventually leading to tooth loss, hallmark feature of the periodontal disease.

To combat the oxidative stress, all the cells in the body are equipped with an intrinsic store of molecules known as “antioxidants.” Antioxidants may be regarded as “those substances which when present at low concentrations, compared to those of an oxidizable substrate, will significantly delay, or inhibit oxidation of that substrate”.<sup>13</sup> They function by scavenging free radicals as and when they form and thereby preventing oxidative stress.

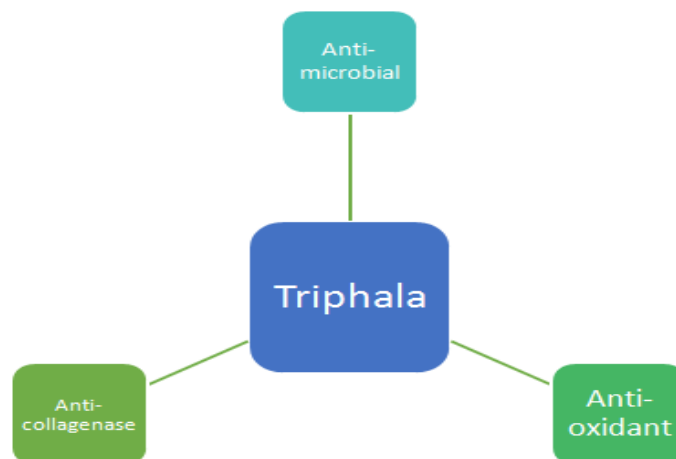
Numerous studies have shown that the total antioxidant capacity in periodontitis patients is significantly lower when compared to healthy controls or in subjects who have received periodontal therapy.<sup>14,15,16</sup> These findings have triggered the use of exogenous supplements for the treatment of periodontal disease.<sup>17</sup> Herbal antioxidant remedies have been the focus of research in recent times.

Turmeric, the most common spice used in households, contains curcumin, which has antibacterial and anti-inflammatory effects.

Turmeric can easily kill the bacteria present in the gums as well as relieve pain and inflammation. It also promotes oral health. In study titled ‘Comparative evaluation of turmeric and chlorhexidine gluconate mouthwash in prevention of plaque formation and gingivitis: a clinical and microbiological study’,<sup>18</sup> suggested that chlorhexidine gluconate as well as turmeric mouthwash can be effectively used as an adjunct to mechanical plaque control methods in prevention of plaque and gingivitis. It could be stated that turmeric is definitely a good adjunct to mechanical plaque control. Further studies are required on turmeric based mouthwash to establish it as a low cost plaque control measure.



Triphala is a well-known powdered preparation in ayurvedic medicine used since ancient time. It consists of equal parts of Amalaki (*Emblica officinalis*), Haritaki (*Terminalia chebula*) and Bahera (*Terminalia bellerica*). Triphala has a strong antimicrobial, antioxidant and anti-collagenase properties.<sup>19</sup> The antioxidants present in Triphala reduce the oxidative burden and protect cells from the damage caused by free radicals. Bahera is the most active antioxidant followed by Amalaki and Haritaki. A clinical trial has shown that Triphala mouthwash is as efficacious as 0.2% chlorhexidine in antiplaque and anti-inflammatory activities.<sup>20</sup>



A study conducted on cinnamon extract on gingival health indicated that cinnamon may prove to be an effective agent owing to its ability to reduce plaque level and gingivitis.<sup>21</sup>

Sumac (*Rhus coriaria*) is a well-known spice used widely as an herbal medicine for its anti-inflammatory, antimicrobial, and antioxidant properties.<sup>22</sup> Sumac extracts have the potential to reduce alveolar bone loss by affecting total oxidative stress levels in periodontal disease in rats.<sup>23</sup>

Green tea which is well known for its benefits of aiding weight loss, is made from the leaves of *Camellia sinensis* that have undergone minimal oxidation during processing. Green tea catechins have been observed to have profound effects on periodontal pathogens. Anaerobic bacteria like *Porphyromonas gingivalis* and *Prevotella* spp. are the main etiological agents in periodontitis. In vitro studies have shown that these compounds inhibit the growth of *P. gingivalis*, *Prevotella intermedia* and *Prevotella nigrescens*.<sup>24,25,26</sup> It also prevents the adherence of *P. gingivalis* onto human buccal epithelial cells.<sup>27</sup> Catechin present in green tea is also highly potent in suppressing the bone resorption mediated by an inflammatory response as seen in periodontal disease.<sup>28</sup> Also, pilot studies on the usage of green tea as a dentifrice and a local drug delivery system have observed an improvement in the periodontal status of the patients suffering from chronic periodontitis.<sup>29,30</sup>

*Rubia cordifolia*, a plant whose roots have been used in ayurvedic medicine. It also contains an organic compound known as Alizarin, which gives the red color to textile dyes. Mollugin, a major component of *R. cordifolia* has been shown to possess anti-inflammatory property.

However, further studies are required to use this herbal product as a novel therapeutic approach to treat bone degenerative disorders such as periodontitis, rheumatoid arthritis, and osteoporosis.<sup>31</sup>

Piperine is an alkaloid which is present in plants such as *Piper nigrum* and *Piper longum*. It is shown to have antioxidant and anti-inflammatory properties.<sup>32</sup> In an animal model on rat periodontitis model revealed that piperine significantly down-regulated the production of interleukin-1 $\beta$ , MMP-8, and MMP-13 (products of

periodontal destruction). Piperine clearly inhibited alveolar bone loss and reformed trabecular microstructures in a dose-dependent manner.<sup>33</sup>

Also, Ginkgo biloba s.p. G. biloba (EGb) leaf extract is among the widely used herbal dietary supplement in the US. Its purported biological effects include scavenging free radicals,<sup>34</sup> lowering oxidative stress<sup>35</sup> and anti-inflammation.<sup>36</sup> In ligature-induced periodontitis rat model, systemic administration of EGb (28-56 mg/kg/day) resulted in reduced osteoclastic counts, decreased inflammation and induced osteoblastic activity.<sup>37</sup>

In Northeastern Brazil, popular medicinal plants like carvacrol and dimeric chalcones are the respective bioactive components of *Lippia sidoides* and *Myracrodruon urundeuva* have proven antimicrobial and anti-inflammatory properties. Alveolar bone loss was significantly inhibited by combined carvacrol and chalcones gel.<sup>38</sup>

*Chamomilla recutita*, a plant is known for its safety and effectiveness in pain relief<sup>39</sup> from aphthous stomatitis and other painful ulcers of the oral mucous membrane. The fluid extract from *Chamomilla recutita*, due to its analgesic effect, may give patients a better quality of life.

Many studies have propagated the use of *Aloe Vera* as it is useful against inflammation of gingiva. It destroys bacteria responsible for gingivitis. It also helps in speeding up of the process of healing. Massaging the aloe gel into the gums has many therapeutic benefits.<sup>40</sup>

Indian lilac, also known as neem, is also very beneficial in getting rid of periodontitis. Its antibacterial properties help keep your gingiva free from harmful bacteria. It helps combat bad breath and keeps your gums and teeth healthy.<sup>41</sup> Extract the juice from a few neem leaves. Apply this juice on the gums and teeth, allow it to sit for 5 minutes and then rinse it off with warm water. Follow this treatment 1 or 2 times daily. Using soft neem twigs to brush your teeth and gums twice daily proves helpful in a long run.

Bloodroot (*Sanguinaria canadensis*) contains a mixture of alkaloids, but chiefly sanguinarine, which is available in commercial toothpastes and mouth rinses and has properties that are useful in preventing dental plaque formation.<sup>42</sup> Use toothpaste containing the extract of sanguinarine.

Gotu kola (*Centella asiatica*) can be put to good use in treating severe periodontal disease. If surgery is required, this botanical can be helpful in speeding recovery after laser surgery for severe periodontal disease.<sup>43</sup> Dosage is based upon triterpenic acid content. Recommended dosage is 30 mg of triterpenoids twice daily.

*Essential oil-containing antiseptic (EO)* is an over-the-counter mouth wash containing 2 phenol-related essential oils. EO is associated with only minimal side effects and kills a wide range of microorganisms by disrupting their cell walls and inhibiting their enzyme activity.<sup>44,45</sup> EO is capable of extracting bacterial endotoxins, which theoretically may reduce plaque pathogenicity. EO significantly reduced subgingival bacterial counts of total bacteria, *Porphyromonas gingivalis* (*P.gingivalis*), and *Tannerella forsythia* (*T. forsythia*).<sup>46,47</sup> Adjunctive use of EO to a combination of Subgingival Ultrasonic Instrumentation) and mouth rinsing is effective in reducing subgingival bacterial counts in both shallow and deep pockets.<sup>48</sup>

Oil pulling or oil swishing therapy is a traditional procedure in which the practitioners rinse or swish oil in their mouth. It is supposed to cure oral and systemic diseases but the evidence is minimal. Oil pulling with sesame oil<sup>49</sup> and sunflower oil was found to reduce plaque related gingivitis. Coconut oil is an easily available edible oil. It is unique because it contains predominantly medium chain fatty acids of which 45-50 percent is lauric acid. Lauric acid has proven anti-inflammatory and antimicrobial effects.<sup>50</sup> A statistically significant decrease in the plaque and gingival indices was noticed from day 7 and the scores continued to decrease during the period of study.

Extra Virgin Olive Oil contains oleic acid and other flavonoids<sup>51</sup> which are anti-inflammatory and antioxidants.<sup>49</sup> If your gums are inflamed, EVOO is one of the best treatments. Take a tablespoon of extra virgin olive oil and swish around your mouth for a couple of seconds and then spit. It will wash away all the toxins. Repeat three times a day for best results.

Clove Oil is one of the most effective treatments to cure gingivitis and other gum related diseases. Rub the gums with clove oil or just chew a piece of clove<sup>52</sup>. Remember, you may experience a burning sensation but this will cure the disease.

In a study titled, 'Effect of avocado and soybean unsaponifiables on gelatinase A (MMP-2), stromelysin 1 (MMP-3), and tissue inhibitors of matrix metalloproteinase (TIMP- 1 and TIMP-2) secretion by human fibroblasts in culture',<sup>53</sup> suggest a potential role for avocado and soy unsaponifiable extracts to prevent the deleterious effects of IL-1beta that occur during periodontal diseases.

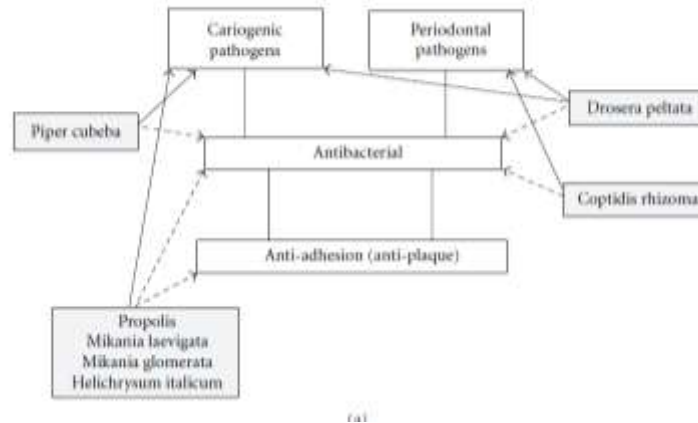
Cranberry Juice has anti-bacterial properties. Numerous studies have investigated the ability of cranberry juice or cranberry constituents to prevent adhesion of oral pathogens to surfaces and related phenomena, such as the production of glucans and fructans,<sup>54</sup> and the formation of biofilms.

Guava being rich in vitamin C, guava is also considered an excellent remedy for periodontitis. It works as an anti-plaque agent and helps remove plaque accumulated<sup>55</sup> on the teeth and gingiva. Its anti-inflammatory and analgesic properties help reduce swelling and pain on the gingiva. Washing some tender guava leaves and

chewing on them thoroughly, then spitting them out. Doing this on a regular basis to stop bleeding and reduce the risk of pus forming in the gums.

Honey is sweet, yet it is beneficial for the peridontium because of its anti-bacterial properties. It is also rich in minerals and vitamins and provides the necessary nutrients for maintaining healthy gums.

In vitro studies have shown that exposure to a honey solution affected monocyte activity. It was found that mouth washes containing propolis (present in bee products) possessed antimicrobial activity against *Streptococcus mutans*<sup>56</sup> and can be used as an alternative treatment in dental caries prevention and in the reduction of plaque accumulation and polysaccharide formation.



Recently it was reported that periodontal pockets irrigated with 10% propolis solution had a 95% decrease<sup>57</sup> in gingivitis suggesting (based on both clinical and microbiological parameters) that subgingival irrigation with a propolis extract as an adjunct to periodontal treatment and more effective than scaling and root planning.<sup>58</sup> These data suggested that topical application/chewing of honey might help prevent gingivitis and caries in patients undergoing orthodontic treatment.<sup>59</sup> Further studies will be required to substantiate these preliminary observations.

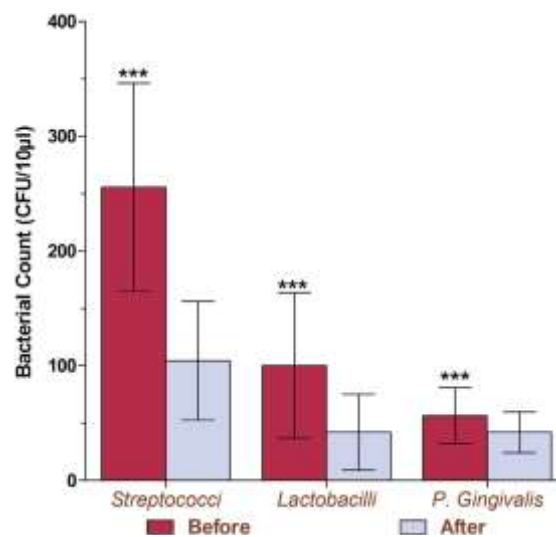


Fig 1. Mean bacterial counts (CFU/10 μl) before and one hour after honey consumption.

## II. CONCLUSION

The herbal medicines have shown to possess a wide array of biological properties such as antimicrobial, antioxidant, and anti-inflammatory effects. The natural phytochemicals present in these herbs aid in suppressing the alveolar bone loss, which is the striking feature in periodontitis. Since herbal therapies aid in effectiveness, safety, accessibility and control over treatment hence can be tried in dentistry as they are used in medical disorders. Although many studies, have shown the potency of herbal medicines as an alternative to conventional therapy, there still lies a void in research with respect to the clinical application of these agents in periodontics. Future targeted trials in learning the mechanism of action of these herbal remedies are warranted.

## REFERENCES

- [1]. World Health Organization. Traditional Medicine. Geneva; 2008. Available from: <http://www.who.int/medicines/areas/traditional/en/>. [Last Accessed date 2015 Nov 01].
- [2]. Jastrow N: The medicin of Babylonians and Assyrians, Proc Soc Med London.7:109, 1914.
- [3]. World Health Organization. The World Medicines Situation 2011. Traditional Medicines: Global Situation, Issues and Challenges. Geneva: WHO; 2011. p. 1-14
- [4]. Barakat NJ, Toto PD, Choukas NC: Aging and cell renewal of oral epithelium. J Periodontol 1969; 40:599
- [5]. Hippocrates: Works, London,1923,1931 Heinemann, (Edited and translated by WHS Jones and ET Whittington)
- [6]. Page RC: Gingivitis. J Periodontol:13:345, 1986.
- [7]. Laine ML, Crielaard W, Loos BG. Genetic susceptibility to periodontitis. Periodontol 2000;58:37-68
- [8]. C. H. Drisko, "Nonsurgical periodontal therapy," Periodontology 2000, vol. 25, no. 1, pp. 77-88, 2001.
- [9]. Matthews AT, Ross MK. Oxyradical stress, endocannabinoids, and atherosclerosis. Toxics2015;3:481-498.
- [10]. Fischer BM, Voynow JA, Ghio AJ. COPD: Balancing oxidants and antioxidants. Int J Chron Obstruct Pulmon Dis 2015;10:261-76.
- [11]. D'Aiuto F, Nibali L, Parkar M, Patel K, Suvan J, Donos N. Oxidative stress, systemic inflammation, and severe periodontitis. J Dent Res 2010;89:1241-6.
- [12]. Devasagayam TP, Tilak JC, Boloor KK, Sane KS, Ghaskadbi SS, Lele RD. Free radicals and antioxidants in human health: Current status and future prospects. J Assoc Physicians India 2004;52:794-804
- [13]. Halliwell B. Antioxidants: The basics – What they are and how to evaluate them. Adv Pharmacol 1997;38:3-20.
- [14]. Chapple IL, Mason GI, Garner I, Matthews JB, Thorpe GH, Maxwell SR, et al. Enhanced chemiluminescent assay for measuring the total antioxidant capacity of serum, saliva and crevicular fluid. Ann Clin Biochem 1997;34:412-21.
- [15]. Sculley DV, Langley-Evans SC. Periodontal disease is associated with lower antioxidant capacity in whole saliva and evidence of increased protein oxidation. Clin Sci (Lond) 2003;105:167-72
- [16]. Brock GR, Butterworth CJ, Matthews JB, Chapple IL. Local and systemic total antioxidant capacity in periodontitis and health. J Clin Periodontol 2004;31:515-21.
- [17]. Shirzaiy M, Ansari SM, Dehghan JH, Ghaeni SH. Total anti-oxidant capacity of saliva in chronic periodontitis patients before and after periodontal treatment. J Nepal Health Res Counc 2014;12:172-6.
- [18]. Waghmare PF, Chaudhari AU, Karhadkar VM, Jamkhande AS. Comparative evaluation of turmeric and chlorhexidine gluconate mouthwash in prevention of plaqueformation and gingivitis: a clinical and microbiological study. J Contemp Dent Pract. 2011 Jul 1;12(4):221-4
- [19]. Vani T, Rajani M, Sarkar S, Shishoo CJ. Antioxidant properties of the ayurvedic formulation triphala and its constituents. Pharm Biol 1997;35:313-7.
- [20]. Naiktari RS, Gaonkar P, Gurav AN, Khiste SV. A randomized clinical trial to evaluate and compare the efficacy of triphala mouthwash with 0.2% chlorhexidine in hospitalized patients with periodontal diseases. J Periodontal Implant Sci 2014;44:134-40.
- [21]. Gupta D, Jain A. Effect of Cinnamon Extract and Chlorhexidine Gluconate (0.2%) on the Clinical Level of Dental Plaque and Gingival Health: A 4-Week, Triple-Blind Randomized Controlled Trial. J Int Acad Periodontol. 2015;Jul;17(3):91-8.
- [22]. Rayne S, Mazza G. Biological activities of extracts from sumac (*Rhus* spp.): A review. Plant Foods Hum Nutr 2007;62:165-75.
- [23]. Saglam M, Köseoglu S, Hatipoğlu M, Esen HH, Köksal E. Effect of sumac extract on serum oxidative status, RANKL/OPG system and alveolar bone loss in experimental periodontitis in rats. J Appl Oral Sci 2015;23:33-41.
- [24]. 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 2014;116:1164-71.
- [25]. Araghizadeh A, Kohanteb J, Fani MM. Inhibitory activity of green tea (*Camellia sinensis*) extract on some clinically isolated cariogenic and periodontopathic bacteria. Med Princ Pract 2013;22:368-72.
- [26]. Okamoto M, Leung KP, Ansai T, Sugimoto A, Maeda N. Inhibitory effects of green tea catechins on protein tyrosine phosphatase in *Prevotella intermedia*. Oral Microbiol Immunol 2003;18:192-5.
- [27]. Sakanaka S, Aizawa M, Kim M, Yamamoto T. Inhibitory effects of green tea polyphenols on growth and cellular adherence of an oral bacterium, *Porphyromonas gingivalis*. Biosci Biotechnol Biochem 1996;60:745-9.
- [28]. Makimura M, Hirasawa M, Kobayashi K, Indo J, Sakanaka S, Taguchi T, et al. Inhibitory effect of tea catechins on collagenase activity. J Periodontol 1993;64:630
- [29]. Hrishi T, Kundapur P, Naha A, Thomas B, Kamath S, Bhat G. Effect of adjunctive use of greentea dentifrice in periodontitis patients - A randomized controlled pilot study. Int J Dent Hyg 2015.
- [30]. 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 2002;37:433-8.
- [31]. Baek JM, Kim JY, Jung Y, Moon SH, Choi MK, Kim SH, et al. Mollugin from *Rubia cordifolia* suppresses receptor activator of nuclear factor- $\kappa$ B ligand-induced osteoclastogenesis and bone resorbing activity in vitro and prevents lipopolysaccharide-induced bone loss in vivo. Phytomedicine 2015;22:27-35.
- [32]. Pradeep CR, Kuttan G. Effect of piperine on the inhibition of nitric oxide (NO) and TNF-alpha production. Immunopharmacol Immunotoxicol 2003;25:337-46
- [33]. Dong Y, Huihui Z, Li C. Piperine inhibit inflammation, alveolar bone loss and collagen fibers breakdown in a rat periodontitis model. J Periodontal Res 2015;50:758-65.
- [34]. Yuan F, Yu R, Yin Y, Shen J, Dong Q, Zhong L, et al. Structure characterization and antioxidant activity of a novel polysaccharide isolated from *Ginkgo biloba*. Int J Biol Macromol 2010;46:436-9.
- [35]. Wang CG, Dai Y, Li DL, Ma KY. *Ginkgo biloba* leaf extract action in scavenging free radicals and reducing mutagenicity and toxicity of cigarette smoke in vivo. J Environ Sci Health A Tox Hazard Subst Environ Eng 2010;45:498-505.
- [36]. Thorpe LB, Goldie M, Dolan S. Central and local administration of *Ginkgo biloba* extract EGb 761® inhibits thermal hyperalgesia and inflammation in the rat carrageenan model. Anesth Analg 2011;112:1226-31.
- [37]. Sezer U, Kara MI, Erciyas K, Ozdemir H, Üstün K, Ozer H, et al. Protective effects of *Ginkgo biloba* extract on ligature-induced periodontitis in rats. Acta Odontol Scand 2013;71:38-44.
- [38]. W. S. Alviano, D. S. Alviano, C. G. Diniz, A. R. Antonioli, C.S. Alviano, L. M. Farias et al., "In vitro antioxidant potential of medicinal plant extracts and their activities against oral bacteria based on Brazilian folk medicine," Archives of Oral Biology, vol. 53, pp. 545-552, 2008.
- [39]. Kazemian H, Ghafourian S, Heidari H, Amiri P, Yamchi JK, Shavali-pour A et al. Antibacterial, anti-swarming and anti-biofilm formation activities of *Chamaemelum nobile* against *Pseudomonas aeruginosa*. Rev Soc Bras Med Trop. 2015 Jul-Aug;48(4):432-6.

- [40]. Chhina S, Singh A, Menon I, Singh R, Sharma A, Aggarwal V. A randomized clinical study for comparative evaluation of Aloe Vera and 0.2% chlorhexidine gluconate mouthwash efficacy on de-novo plaque formation. *J Int Soc Prev Community Dent.* 2016 May-Jun;6(3):251-5.
- [41]. Balappanavar AY, Sardana V, Singh M. Comparison of the effectiveness of 0.5% tea, 2% neem and 0.2% chlorhexidine mouthwashes on oral health: a randomized control trial. *Indian J Dent Res.* 2013 Jan-Feb;24(1):26-34.
- [42]. Hong SJ<sup>1</sup>, Jeong SS, Song KB. Effects of sanguinaria in fluoride-containing dentifrices on the remineralisation of subsurface carious lesion in vitro. *Int Dent J.* 2005 Jun;55(3):128-32.
- [43]. Sastravaha G<sup>1</sup>, Gassmann G, Sangtherapitikul P, Grimm WD. Adjunctive periodontal treatment with *Centella asiatica* and *Punica granatum* extracts in supportive periodontal therapy. *J Int Acad Periodontol.* 2005 Jul;7(3):70-9.
- [44]. J.-P. Ouhayoun, "Penetrating the plaque biofilm: impact of essential oil mouthwash," *Journal of Clinical Periodontology*, vol. 30, supplement 5, pp. 10–12, 2003.
- [45]. J. E. Stoeken, S. Paraskevas, and G. A. van der Weijden, "The long-term effect of a mouthrinse containing essential oils on dental plaque and gingivitis: a systematic review," *Journal of Periodontology*, vol. 78, no. 7, pp. 1218–1228, 2007.
- [46]. Lakhdar L, Hmamouchi M, Rida S, Ennabi O. Antibacterial activity of essential oils against periodontal pathogens: a qualitative systematic review. *Odontostomatol Trop.* 2012 Dec;35(140):38-46.
- [47]. Fine DH, Markowitz K, Furgang D, Goldsmith D, Ricci-Nittel D, Charles CH, Peng P et al. Effect of rinsing with an essential oil-containing mouthrinse on subgingival periodontopathogens. *J Periodontol.* 2007 Oct;78(10):1935-42.
- [48]. Morozumi T, Kubota T, Abe D, Shimizu T, Nohno K, Microbiological effect of essential oils in combination with subgingival ultrasonic instrumentation and mouthrinsing in chronic periodontitis patients. *Int J Dent.* 2013;2013:146479.
- [49]. Singla N<sup>1</sup>, Acharya S<sup>1</sup>, Martena S<sup>2</sup>, Singla R. Effect of oil gum massage therapy on common pathogenic oral microorganisms - A randomized controlled trial. *J Indian Soc Periodontol.* 2014 Jul;18(4):441-6.
- [50]. Peedikayil FC, Sreenivasan P, Narayanan A. Effect of coconut oil in plaque related gingivitis - A preliminary report. *Niger Med J.* 2015 Mar-Apr;56(2):143-7.
- [51]. C. A. Rice-Evans and N. J. Miller, "Antioxidant activities of flavonoids as bioactive components of food," *Biochemical Society Transactions*, vol. 24, no. 3, pp. 790–795, 1996.
- [52]. Shivayogi Charantimath, Rakesh Oswal, *Herbal Therapy in Dentistry: A Review*, *Innovative Journal of Medical and Health Science* 1: 1 (2011) 1 – 4.
- [53]. Kut-Lasserre C<sup>1</sup>, Miller CC, Ejeil AL, Gogly B, Dridi M, Piccardi N. Effect of avocado and soybean unsaponifiables on gelatinase A (MMP-2), stromelysin 1 (MMP-3), and tissueinhibitors of matrix metalloproteinase (TIMP- 1 and TIMP-2) secretion by human fibroblasts in culture. *J Periodontol.* 2001 Dec;72(12):1685-94.
- [54]. B. Johnson-White, L. Buquo, M. Zeinali, and F. S. Ligler, "Prevention of nonspecific bacterial cell adhesion in immunoassays by use of cranberry juice," *Analytical Chemistry*, vol. 78, no. 3, pp. 853–857, 2006.
- [55]. Mittal P, Gupta V, Kaur G, Garg AK, Singh A. Phytochemistry and pharmacological activities of *Psidium guajava*: A review. *Int J Pharm Sci Res* 2010;1:9-19.
- [56]. Duailibe, S.A., Goncalves, A.G., Ahid, F.J., 2007. Effect of a propolis extract on *Streptococcus mutans* counts in vivo. *J. Appl. Oral Sci.* 15, 420–423.
- [57]. do Amaral, R.C., Gomes, R.T., Rocha, W.M.S., Lemos, S., Abreu, R., Santos, V.R., 2006. Periodontitis treatment with Brazilian green propolis gel. *Pharmacology (online)*, 336–341.
- [58]. Ahuja, V., Ahuja, A., 2011. Apitherapy—a sweet approach to dental diseases. Part II: propolis. *J. Acad. Adv. Dent. Res.* 2, 1–8.
- [59]. AL-Dany A Atwa et al ;Effect of honey in preventing gingivitis and dental caries in patients undergoing orthodontic treatment. *The Saudi Dental Journal* (2014) 26, 108–114