

# BENEFITS OF PHYTOTHERAPY IN PERIODONTICS: A REVIEW

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## Abstract:

The knowledge on medicinal plants has been accumulated in the course of many centuries, based on different medicinal systems such as Ayurveda, Unani and Siddha. In India, it has been reported that traditional healers use 2,500 plant species and that 100 species of plants serve as regular sources of medicine. 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 their continuous intake has resulted in antibiotic resistance. Periodontal diseases are highly prevalent and can affect up to 90% of the world population. Gingivitis is the mild form whereas periodontitis is an irreversible loss of supporting structures of the teeth. Periodontal pathogens form a crucial component in the etiopathogenesis of periodontitis hence, there is a growing evidence that these pathogens can be reduced by herbal extracts and herbal products. This review article mainly focuses on the herbal extracts and phototherapeutic medicine which can be useful in prevention and treatment of gingivitis and periodontitis.

## Introduction:

Phytotherapeutics are extracted from medicinal plants and their active ingredients may relieve symptoms and even cure diseases, though they occasionally present adverse effects (TROJANRODRIGUES et al, 2012). It is estimated that 25% of the Brazilian pharmaceutical industry's earnings are obtained by the sales of plants derivatives, and these revenues continue to grow each year (MINISTÉRIO DE SAÚDE, 2006). In order to control the consumption of these products, many countries created their own regulations. In Brazil, medical, anthropological-social, botanical-economic and economic criteria are taken in consideration by the Plant Selection Committee (MINISTÉRIO DE SAÚDE, 2006). Drugs which are of plant origin and used to treat diseases to attain or maintain the condition of improved health are known as herbal drugs <sup>[6]</sup>.

Herbal excipients are non-toxic and compatible, they have a major role to play in pharmaceutical formulation. The effectiveness of any herbal medication is dependent on the delivery of effective level of therapeutically active compounds. Thus, the focus of attention has revolved back to herbal medicines due to their wide spectrum of biological and medicinal activities, lower cost, and higher safety margins. Herbs and their extracts are used to stimulate superficial circulation, increase elimination of harmful substances and reduce inflammation and irritation. Herbal products may be used as pills, syrups and infusions or externally as creams, mouthwash and ointments.

Periodontitis is a chronic inflammatory disease which results in the destruction of supporting structures of the teeth. The etiology is multifactorial with periodonto-pathogens forming a major crux in the initiation and progression of the disease. Various antimicrobial and chemotherapeutic agents, such as chlorhexidine, triclosan, cetylpyridinium chloride, have been tried and tested in the management of periodontal disease. The side effects of these medicines are well known such as staining of teeth and allergies which limits the use of these medicines. Therefore, herbal remedies have been sought to achieve antimicrobial, antioxidant, antiseptic, anti-inflammatory, and anti-collagenase effects without any known side effects.

Different herbs available are as follows:

### **1: Matricaria recutita or Matricaria chamomilla (Chamomile):**

Several daisy-like plants of the family Chamomile (*Matricaria recutita*) belongs to Asteraceae family and it is one of the most popular herbs. Wild Chamomile is an annual herb originally from Europe. The branched stem is erect, round, hollow, and grows to about 20 inches tall. The leaves are bipinnate, finely divided, light green and feathery.

**Medicinal Properties:** Chamomile, has been shown to be anxiolytic, anti-stress and anti-allergic reactions. Chamomile is one of the most widely used flowers for herbal tea.

**Uses in systemic conditions:** It is used as a mild sedative and is good for insomnia as well as many other nervous conditions. Chamomile flowers are also used as anti-inflammatory and antispasmodic. The flowers are sometimes added to cosmetics as an anti-allergenic agent or made into a salve for use on hemorrhoids and wounds. The dried herb is made into pot pouri and herb pillows, and is burned for aromatherapy.

**Uses in gingival and periodontal conditions:** It is used as an ingredient of mouthrinse and in prevention and treatment of gingivitis and periodontal disease<sup>[27]</sup>. It can also be used in the form of capsules, tablets, or tinctures. McKay and Blumberg demonstrated anti-inflammatory activity in an animal model study. Lucena et al. , found a reduction in the gingiva bleeding index, confirming the findings of this study, in which the mouthwash with *Matricaria recutita* extract also reduced the bleeding index, both in gingivitis and in chronic periodontitis, showing statistically significant results ( $p < 0.05$ ) in the different assessment periods (0,7 and 15 days). Batista et al. [33] used chamomile and pomegranate extracts mouthwashes, which were effective in reducing gingival bleeding in periodontal disease, suggesting that both extracts have anti-inflammatory and antimicrobial actions similar to those of the chlorhexidine 0.12%, and thus can also be used as additional therapeutic agents to reestablish and maintain periodontal health. There have been reports of allergic reactions to chamomile (*Matricaria recutita*) [34]. These reactions were followed by bronchial constriction with systemic administration and skin reactions after topical application [35]. The active compounds in the chamomile are  $\alpha$ -bisabolol and spiroether, which inhibit the secretion of histamine, serotonin and bradykinin. In vitro and in vivo studies report the fact that chamomile causes wounds to heal sooner than corticosteroid treatment (Martins MD, Marques MM (2009)). The herb stimulates faster formation of the epithelium (Duarte CM, Quirino MR, Patrocínio MC, et al. (2011)).

## 2: Salvia officinalis (Sage):

Sage belongs to Lamiaceae family. Sage grows in the fields and along roadsides.

**Medicinal Properties:** Sage essential oils have antibiotic, antifungal, antiseptic, and antiviral properties. *Salvia officinalis* also exhibits antioxidant, free radical scavenging activity and antibacterial action. Mainly the leaves of sage are used

**Uses in systemic conditions:** *Salvia* deals effectively with throat infections, it has been used to reduce inflammatory process in stomatitis and pharyngitis<sup>[23]</sup>

**Uses in gingival and periodontal conditions:** Delamare et al (2007) carried out a study on antibacterial activity of the essential oils of *Salvia officinalis* and *Salvia triloba*. The major constituents of the oil of *S. officinalis* were  $\alpha$ -thujone, 1,8-cineole, camphor, borneol, and  $\beta$ -pinene, whereas those of *S. triloba* were  $\alpha$ -thujone, 1,8-cineole, camphor, and  $\beta$ -caryophyllene. The antibacterial activity of these two extracts against *Streptococcus mutans*, *Lactobacillus rhamnosus*, and *Actinomyces viscosus* were evaluated through broth macrodilution method. They concluded that the essential oils of both species exhibited remarkable bacteriostatic activities against *Staphylococcus aureus* and *A. hydrophila*. Joanne Smullen (2012) performed a study to prove that plant extracts can inhibit formation of dental plaque. The ability of extracts of *Rosmarinus officinalis* L., *Salvia officinalis* L., unfermented cocoa, red grape seed, and green tea to inhibit plaque bacteria, glucosyltransferase activity, glucan, and plaque formation in an in vitro model using bovine teeth was examined. The results suggested that the extracts of *R. officinalis* L. and *S. officinalis* L. may be useful as antiplaque agents. For its bactericidal properties, *Salvia officinalis* is adequate to kill bacteria that cause halitosis. Mouthwashes of *Salvia officinalis* is prepared by making an infusion of a spoonful of dried plant per cup of water. It can be used as mouth rinse and it has been recommended for treatment of sore throat, stomatitis, gingivitis and periodontal disease. For therapy: 3g of sage chopped leaf could be added to 150 ml of boiling water for 10 minutes. Then, it can be used as a mouth rinse several times a day. Another prescription for mouth rinse is: two tablespoon of sage chopped leaf immersed in half a liter of water, covered and brought to a boil and then left covered for 15 minutes- this can be used for gargling several times a day for 5 to 10 minutes<sup>[24]</sup>. *Salvia officinalis*, *Mentha piperita* (Umbelliferae), *Eugenia caryophyllus* (Myrtaceae) and *Echinacea purpurea*<sup>[25]</sup>, *Salvia officinalis* has aromatic, spasmolytic, antiseptic, astringent properties and when it is taken as a mouthwash in gingivitis and mouth ulcers<sup>[26]</sup>. Drinking sage tea is not recommended during pregnancy and lactation, but mouth rinse and gargling is allowed<sup>[27]</sup>.

## 3: Azadirachata indica (Neem):

*Azadirachta indica* is the most commonly used traditional medicinal plant of India. *Azadirachta indica* (syn. *Melia azadirachta*) is well known in India and its neighbouring countries for more than 2000 years as one of the most versatile medicinal plant having a wide spectrum of biological activity.

Biological activity of Neem is reported with the crude extracts and their different fractions from leaf, bark, root, seed and oil. Limnoids (triterpenoids), nimbin, nimbinin, and nimbidin,  $\beta$ -sitosterol, desacetylnimbinene, nimbandiol, nimbolide and quercetin, n-hexacosanol and nonacosane. The leaves contain 6- desacetyl nimbinene, nimbandiol, nimbolide and quercetin, n-hexacosanol and nonacosane. The diterpenoids margolone, nimbogone, nimbonolone and nimbolinin have also been isolated from the plant.

**Medicinal Properties:** Neem shows antiulcer, anti-inflammatory, anti-fungal, antibacterial, anti-carcinogenic, antiarrhythmic, antiviral, antiarthritis, hepatoprotective, antidiabetic activity and antioxidant properties.

**Uses in systemic conditions:** Neem oil, bark and leaf extract have been therapeutically used as folk medicine to control leprosy, intestinal helmenthis, respiratory disorders, constipation, rheumatism, malaria, diabetes, chronic syphilitic sores and indolent ulcer.

**Uses in Gingival and Periodontal conditions:** Rao AR (1969), Chatterjee A (1994), Ratika S (2014) studied the anti-inflammatory properties of neem in gingivitis. Hall EE (1997) stated that neem acts by the removal or inhibition of subgingival plaque and maintenance is dependent on continued plaque control<sup>[76]</sup>. Sorna K (2011), Amir M (2012), Sonal Dubey (2014), R Pandya Sajankumar (2015) studied the antimicrobial effectiveness of neem on streptococcus mutans. Verdine Virginia Antony (2013), Abhay Gupta (2017), in their study came to a conclusion that local drug delivery of neem gel can be effective for treatment of chronic periodontitis. Mithun D Kudalkar (2014) showed inhibitory effect of neem and aloe vera on MMP -2 and MMP which are involved in extra cellular matrix degradation during periodontitis. Bhushan S kala et al (2015) stated in their study that neem-extract dental gel reduced bacteria present in plaque i.e Streptococcus mutans and Lactobacilli species significantly<sup>[13]</sup>. K Vennila (2016) in her study showed that 10 % neem chip can be effectively used as an adjunct to scaling and root planning in treatment of chronic periodontitis.

#### **4: Curcuma Longa (Turmeric):**

Turmeric commonly known as Haldi and has been used for thousands of years as a dye, a flavoring and a medicinal herb. It is a rhizomatous herbaceous perennial plant of family Zingiberaceae. It is native to tropical South Asia and needs temperatures between 20 °C and 30 °C. Haldi is a perennial plant with orange, oblong tubers 2 or 3 inches in length and one inch in diameter, pointed or tapering at one end<sup>[48,49]</sup>.

**Medicinal properties:** Turmeric has anti-inflammatory, antimicrobial, antiseptic, anti-mutagenic, antioxidant, hepato-protective, immune-stimulant, astringent<sup>[3,8]</sup>.

**Uses in systemic conditions:** When dried, it is made into a yellow powder with a bitter, slightly acrid, yet sweet taste. Ancient Indian medicine has touted turmeric as an herb with the ability to provide glow and luster to the skin as well as vigor and vitality to the entire body.

**Uses in gingival and periodontal conditions:** Turmeric reduces inflammation by lowering histamine levels and possibly by increasing the production of natural cortisone by the adrenal glands( Ammon HP, Safayhi H, Mack T, Sabieraj J 1993).Applying a paste made from 1 tsp of turmeric with ½ tsp of salt and ½ tsp of mustard oil provides relief from gingivitis and periodontitis. Rub the teeth and gums with this paste twice daily. A separate double-blind clinical trial found that curcumin was superior to placebo or phenylbutazone (a non-steroidal anti-inflammatory drug [NSAID]) for alleviating post-surgical inflammation(T P Chaturvedi 2009) also it protects against free radical damage because it is a strong antioxidant( Ramirez-Boscá A, Soler A, Gutierrez MA 1995). The efficacy of 0.1% turmeric mouthwash as an antiplaque agent and its effect on gingival inflammation was done and it was found that it can be effectively used as an adjunct to mechanical plaque control in prevention of plaque and gingivitis (Venisha Pandita et al 2014).

## 5: Aloe vera (Aloe vera):

Aloe vera belongs to Asphodelaceae (Liliaceae) family. More than 300 species of aloe plants exist. Ideal environment to grow this plant is tropical climate and low-rainfall areas<sup>[28,29]</sup>. It is shrubby or arborescent, perennial, xerophytic, pea-green colour plant. It grows mainly in the dry region of Africa, Asia, Europe and America. In India it is found in Rajasthan, A.P., Gujarat, Maharashtra and Tamilnadu. The Aloe vera leaf consists of 2 different parts: central mucilaginous part and peripheral bundle sheath cells. The parenchymal tissue makes up the inner portion of the aloe leaves and produces a clear, thin tasteless jelly-like material called Aloe vera gel<sup>[2]</sup>. The species is frequently used in cosmetics.

**Medicinal Properties:** Aloe vera (gel formula) is a non-toxic bactericide and it has antiviral, antifungal, anti-inflammatory, analgesic properties and immune-stimulating properties. The anti-inflammatory activity of Aloe vera inhibits the cyclooxygenase pathway and reduces prostaglandin E2 production<sup>[1, 30]</sup>.

**Uses in systemic conditions:** It is also used in conditions including diabetes, asthma, epilepsy and osteoarthritis. Aloe was used topically to heal wounds, skin diseases and orally as a laxative. FDA has approved it as a natural food flavoring agent. Traditionally, it contains vitamins, enzymes, minerals, sugars, fatty acids, amino and salicylic acids. Aloe vera (in the form of a gel) improves wound healing and it can be used for burns, insect-bites and many other skin and mucosal lesions<sup>[1]</sup>

**Uses in gingival and periodontal conditions:** Noskova (1966) showed that Aloe vera was effective in treatment of early stages of periodontitis. Hegger et al 1979 showed its antibacterial properties against *Candida albicans*, *Streptococcus pyogenes*, *Streptococcus fecalis*. Heggens and Robson in 1983 showed that barbolin and aloe emodin in aloe vera block prostaglandin (PG) synthesis. Aloe Vera gel is extremely helpful in the treatment of gum diseases like gingivitis, periodontitis. Grindlay D(1986). Rocio Bautsta in 2004 showed that carboxypeptidase in Aloe vera had good anti-prostaglandin synthesis properties and compounds inhibiting oxidation of arachidonic acid, which might decrease inflammation. The decrease in gingival index can be attributed to presence of sterols as anti-inflammatory agents and lupeol as an antiseptic analgesic. Aloe vera has numerous healing properties, it has been used as dietary supplement and powerful antioxidant, as wound healing accelerator, after periodontal surgery, for traumatized gingival lesions by toothbrush, toothpick or solid food. Scherer et al(1998) confirmed that a mouth rinse, which contains Aloe vera, reduces gingival inflammation and bleeding<sup>[31]</sup>. A short-term study by Bhat et al demonstrated that aloe vera gel showed significant decrease in pocket depth and relative decrease in gingival and plaque indices, when applied subgingivally. Aloe vera gel applications directly to the site of periodontal surgery or to gingiva when it has been traumatized with a tooth brush dentifrice, sharp foods, dental floss and toothpick injuries have shown improved healing properties. Aloe vera gel at optimum concentrations in toothpastes or mouthwashes could be useful for prevention of periodontal diseases and dental caries<sup>[32]</sup>.

## 6: Mentha piperita (Peppermint):

Peppermint (Mint) belongs to Lamiaceae family. *Mentha piperita* essential oil is approved for internal as well as external use. Internal uses include treatment of spastic discomfort of the upper gastrointestinal tract and bile ducts and inflammation of the oral mucosa. It can be used externally for myalgia (muscular pain), neuralgia (pain associated with nerves) and as an antimicrobial and antiseptic.

**Medicinal properties:** The most important phenolic compounds in *Mentha* species are flavonoids and they have a wide range of pharmacological activity: antioxidant, antiulcer, cytoprotective, chemopreventive and anti-inflammatory [36].

**Uses in systemic conditions:** Peppermint oil, when used locally, has an analgesic effect [24].

**Uses in gingival and periodontal conditions:** Peppermint oil is used for toothache. Soak a cotton ball in the oil and place it in the cavity or rub it on the tooth. Peppermint mouthwash is used to relieve gingival inflammation [1,27]. Peppermint is essential oil derivative and its leaves are most commonly used and is available as aromatic water, toothpaste, gel. Peppermint leaf tablets and capsules, 3–6 g per day, diluted, could be used as a mouth rinse to reduce gingival inflammation after periodontal treatment [27]. Evidence that four *M. piperita* essential oils from various sources, and its components, menthol and methone are active against *Staphylococcus aureus*, *S. epidermis*, *K. pneumoniae*, *E. coli* and *C. albicans*, was found. The antibacterial activity of the essential oils and methanol was 0.63 mg/ml, 2.5 mg/ml, 1.25-2.5 mg/ml and 0.63-2.5 mg/ml for *S. aureus*, *K. pneumoniae*, *E. coli* and *S. epidermis* respectively. Menthone was generally less active than menthol; however against *S. mutans* menthol showed weak activity at 400 µg/ml. An Minimum Inhibitory Concentration of 0.31-0.63 mg/ml was obtained for the essential oils and methanol against *C. albicans*. However, menthone exhibited an Minimum Inhibitory Concentration of 2.5 mg/ml against *C. albicans*. Previous investigations of the oil composition were consistent with this result (İşcan, G., Kirimer (2002)).

Although the oil, leaf extract and aqueous extracts are considered safe, the concentration of pulegone should be limited to 1%.

## **7: Ocimum sanctum (Tulsi):**

In Ayurveda, Tulsi (*Ocimum sanctum* L.) has been well documented for its therapeutic potential and described as Dashemani Shwasaharni (antiasthmatic) and antikaphic drugs (Kaphaghna). The traditional medical practitioners in India have been widely using this medicinal plant for management of various disease conditions from ancient time. Carracrol and Tetpene are the antibacterial agents present in this plant.

**Medicinal properties:** Different parts of Tulsi plant e.g. leaves, flowers, stem, root, seeds etc. are known to possess therapeutic potentials and have been used by traditional medical practitioners as expectorant, analgesic, anticancer, antiasthmatic, antiemetic, diaphoretic, anti-diabetic, antifertility, hepatoprotective, hypotensive, hypolipidemic and antistress agents [3].

**Uses in systemic conditions:** Tulsi has also been used in treatment of fever, bronchitis, arthritis, convulsions etc. In an in-vitro study the various concentrations of the Tulsi extracts have been assessed against streptococcus mutans and concluded that the Tulsi extract 4% has a maximum antimicrobial potential. Tulsi can act as COX-2 inhibitor, like modern analgesics due to its significant amount of Eugenol (1 - hydroxyl - 2methoxy - 4 allyl benzene). Tulsi leaves contain 0.7% volatile oil comprising about 71% eugenol and 20% methyl eugenol [37]. Tulsi contains Vitamin A and C, calcium, zinc and iron. It also has chlorophyll and many other phytonutrients. Deficiency of these nutrient has been associated with variety of oral diseases [42]. The leaves have also been shown to possess good anti-stress and analgesic activity. Due to its immune modulating property, *Ocimum sanctum* may find its potential use in treating immunologically mediated mucosal condition like pemphigus [39].

Ocimum sanctum at a dose of 100 mg/kg was found to be effective antiulcer agent in a study. Anti-ulcer effect of Ocimum sanctum may be due to its cytoprotective effect rather than antisecretory effect<sup>[38]</sup>.

**Uses in gingival and periodontal conditions:** Tulsi leaves are quite effective in treating common oral infections. Also few leaves chewed help in maintaining oral hygiene. Tulsi leaves dried in sun and powdered can be used for brushing teeth<sup>[13, 40]</sup>. It can also be mixed with mustard oil to make a paste and used as toothpaste. Tulsi has also proven to be very effective in counteracting halitosis<sup>[13]</sup>. Literature search revealed very few studies that have tested the antimicrobial action of Ocimum sanctum (Linn.) on oral disease causing organisms. A triple blind randomised clinical trial which tested 4% w/v of Ocimum sanctum (Linn.) mouthrinse against 0.12% chlorhexidine mouthwash and saline water as placebo found that Ocimum sanctum mouthrinse was equally effective in reducing plaque and gingivitis as chlorhexidine (Gupta D 2014). Hoadurga et al in 2015 conducted a study to evaluate the anti-inflammatory activity and to assess the duration of action and efficacy of 2% tulsi gel in treatment of periodontitis in Wistar Albino rat model. It was found that 2% tulsi was effective in the treatment of experimental periodontitis. Its anti-inflammatory property makes it a suitable remedy for gingivitis and periodontitis, and it can be used for massaging the gingiva in these conditions<sup>[41]</sup>.

### **8: Punica granatum (Pomegranate):**

Punica granatum (family Punicaceae), generally known as “pomegranate,” is a shrub or small tree native to Asia where several of its parts have been used as astringent, and for hemostatic as well as diabetic control.

**Medicinal properties:** Pomegranate fruit extract contains anthocyanins, glucose, ascorbic acid, ellagic acid, gallic acid, caffeic acid, catechin, epigallocatechin, quercetin, rutin, iron and amino acids possessing excellent anti-inflammatory, anti-oxidant, anti-inflammatory, anti-proliferative, apoptotic effects and possibly immuno-regulatory action on macrophages and T and B lymphocytes.

**Uses in systemic conditions:** The fruit of this tree is used for the treatment of throat infections, coughs, and fever due to its anti-inflammatory property<sup>[13]</sup>.

**Uses in gingival and periodontal conditions:** Pomegranate fruit extract gel was active against *S. sanguis*, *S. mutans* and *S. mitis* by inhibiting their adhesion on to the glass surface and that it could be used to prevent adherence of various microorganisms in the oral cavity. Sastravaha et al. concluded in their preliminary study that local delivery with *Centella asiatica* and *Punica granatum* extracts following scaling and root planning showed significant improvements in pocket depth and attachment level compared to placebo<sup>[10]</sup>. Research showed that pomegranate extract was more effective against the adherence of biofilm microorganisms than a pharmaceutical antifungal, when three or four microorganisms were involved. Investigators noted that pomegranate’s active components, including polyphenolic flavonoids (e.g., punicalagins and ellagic acid) are believed to prevent gingivitis through a number of mechanisms including reduction of oxidative stress in the oral cavity and direct removal of plaque from the teeth ( Bhushan.S.Kala et al 2015)<sup>[13]</sup>.

### 9: Psidium Guajava (Guava):

*Psidium guajava* (Myrtaceae) family has been used traditionally to maintain oral hygiene. While other parts of the plant have various bioactive properties. The active constituents of guava are Saponins, tannins, flavonoids, and alkaloids. The parts used of *Psidium guajava* are fruit, twigs, root and bark.

**Medicinal properties:** Astringent, diuretic, analgesic, anti-inflammatory, hepatoprotective, antioxidant, anti-allergy, antimicrobial, antigenotoxic, antiparasitic, antispasmodic and antinociceptive.

**Uses in systemic conditions:** *Psidium guajava* can be used in hypertension, asthma, it also has cardioactive, anticough and antidiabetic property. Guava has an excellent antioxidant property because it is primarily rich in Vitamin C (Ascorbic acid). It also has quercetin, carotenoids, and polyphenols which augment its antioxidant action. Guava leaf extracts and essential oil from the stem have the ability to scavenge hydrogen peroxide, superoxide anion and inhibit the formation of hydroxyl radical.

**Uses in gingival and periodontal conditions:** The decoction of the root bark is recommended as a mouthwash and decoction of leaves as an effective gargle for bleeding gums<sup>[9,14]</sup>.

The bioactive components of guava are present in its leaves that can fight against pathogens. The leaves of guava contain an essential oil rich in cineol, tannins, triterpenes, flavonoids, resin, eugenol, malic acid, fat, cellulose, chlorophyll, mineral salts, and a number of other fixed substances<sup>[10,51,52,53]</sup>. The paste of tender leaves of *Psidium guajava* (Myrtaceae) has been used traditionally to maintain oral hygiene, while other parts of the plant have various bioactive properties. A methanol extract of *P. guajava* leaves was shown to exhibit inhibitory activity against two strains of *S. mutans*. Fractionation guided by bioautography yielded the active compound, quercetin-3-O- $\alpha$ -l-arabinopyranoside or guaijaverin, which had MIC values of 2–4mg/ml–1. At sub-Minimum Inhibitory Concentration values, guaijaverin was also able to inhibit acid production of the test bacteria, decrease the hydrophobicity of one of the bacteria and inhibit the adherence of both bacteria to glass. The anti-adherent properties of this plant were supported by the reduction of cell-surface hydrophobicity observed in “early settler” plaque bacteria (*S. mitis*, *S. sanguinis* and *Actinomyces*) exposed to 1mg/ml–1 *P. guajava* extract (F. A. Razak, R. Y. Othman, and Z. H. Rahim 2006)<sup>[69]</sup>. The active flavonoid compound guaijaverin - extracted from leaves has high potential antiplaque activity by inhibiting the growth of *S. mutans* and *S. aureus* in a study carried out by disc diffusion method<sup>[10,54]</sup>

### 10: Allium sativum (Garlic):

Historically, garlic was used in China to lower blood pressure, in Egypt to increase physical strength, in India as a home remedy for minor ailments like flu and cough. Garlic has been used not only to flavour food but also because it contains a sulfur-rich derivative of cysteine felt to have medicinal benefits. Parts used of garlic is bulb.

**Medicinal properties:** Antibacterial, antifungal, antiviral and anticarcinogenic.

**Uses in systemic conditions:** Its anticarcinogenic actions may be explained by particular organo-sulfur compounds. Diallyl sulfide, responsible in part for its strong taste and odor, has been shown to selectively inhibit and induce certain P-450 enzymes<sup>[13,60]</sup>. Also effective in Cardiovascular diseases, hypertension, diabetes and hyperlipidemia



**Uses in gingival and periodontal conditions:** Garlic is one of the recommended alternatives to antibiotics<sup>[54,55]</sup>. Allicin, one of the chief phytochemical components of freshly crushed garlic homogenates has a variety of antimicrobial activities. Allicin in its pure form was found to exhibit anti-bacterial activity against a wide range of Gram-negative and Gram-positive bacteria including Klebsiella, pneumonia, Escherichia, Lactobacilli, Helicobacter pylori, Pseudomonas aeruginosa and Mycobacterium tuberculosis and anti-fungal activity, particularly against Candida albicans, antiparasitic activity and antiviral activity. The main antimicrobial effect of allicin is due to its chemical reaction with thiol groups of various enzymes<sup>[57]</sup>. Groppo et al. have observed a remarkable reduction of S.mutans after gargling with a 2.5% garlic mouthwash solution<sup>[58]</sup>.

Bachrach G 2011 study assessed the antimicrobial activity of garlic allicin on periodontal pathogens. It inhibited the growth of Aggregatibacter actinomycetemcomitans and Fusobacterium nucleatum at a minimum allicin concentration of 300 µg/ml, but P. gingivalis showed low sensitivity to allicin. However, this study emphasized the use of allicin for alleviating dental diseases and stressed the need for further studies<sup>[59]</sup>.

### **11: Syzygium aromatum , L.Myrtaceae, Eugenia caryophyllata (Cloves):**

The essential oil extracted from the dried flower buds of clove, Eugenia caryophyllata L. Merr. & Perry (Myrtaceae) is used as a topical application to relieve pain and to promote healing. The main constituents of the essential oil are phenyl propanoids such as carvacrol, thymol, eugenol and cinnamaldehyde.

**Medicinal properties:** The biological activity of Eugenia caryophyllata has been investigated on several microorganisms and parasites, including pathogenic bacteria, herpes simplex and hepatitis C viruses. Eugenia caryophyllata possess antimicrobial, antioxidant, antifungal and antiviral activity, clove essential oil possesses anti-inflammatory, cytotoxic, insect repellent antiseptic, stimulant, antiemetic (vomiting preventive) properties and anaesthetic properties<sup>[2, 27,64]</sup>.

**Uses in systemic conditions:** Clove also contains a variety of flavonoids, including kaempferol and rhamnetin, which also contribute to clove's anti-inflammatory (and antioxidant) properties<sup>[63]</sup>. Gargling with diluted clove oil helps in relieving throat pain and irritation.

**Uses in gingival and periodontal conditions:** The dried flower buds of an East Indian evergreen tree, cloves are popularly used as a spice. They also yield a volatile oil used medicinally and in perfumes. The composition was formulated in the form of a liquid or a gel which moistened a single-use disposable sterile cotton roll to be received in a buccal vestibule. The system was therapeutically effective in treatment of periodontal diseases on topical administration<sup>[2,65]</sup>. Eugenol extracts from clove is used in general gum pain, since eugenol and other components of clove (including betacaryophyllene) combine to make clove a mild anaesthetic as well as an anti-bacterial agent. Eugenol, the primary component of clove's volatile oils, functions as an anti-inflammatory substance. The characteristic smell of clove oil also helps to eliminate bad breath<sup>[8]</sup>.

## 12: Melaleuca alternifolia (Tea tree oil):

Tea tree oil (TTO) is extracted from the tree *Melaleuca alternifolia*, a native of Australia. **Medicinal Properties:** Tea tree oil has been known to have many valuable medicinal uses as an antiseptic, antifungal and antibacterial agent<sup>[10]</sup>. The in vitro activity of *Melaleuca alternifolia* against 161 isolates of oral bacteria from 15 genera was determined. Tea tree oil is composed of terpene hydrocarbons, like monoterpenes, sesquiterpenes their associated alcohols and other several varieties, or chemotypes.

**Uses in systemic conditions:** Tea Tree Oil has antimicrobial property and is used in the superficial treatment of skin infections.

**Uses in gingival and periodontal conditions:** Elgendy EA et al (2013) indicated in their study that a range of oral bacteria which includes *Actinomyces* species, *Lactobacillus*, *S. mitis*, *S. sanguis*, *Prevotella*, *Fusobacterium* and *Lactobacillus* are susceptible to tea tree oil, suggesting that tea tree oil may be of use in oral health care products and in the maintenance of oral hygiene<sup>[73]</sup>. Tea tree oil is widely used in periodontal diseases as it helps in controlling bad breath, plaque formation, bleeding gums. It can be applied directly on the inflamed gums, for instant relief<sup>[7,27]</sup>. In addition to their inhibitory and bactericidal activities, most of the oils were able to inhibit the adhesion of *S. mutans* and *P. gingivalis*. Tea tree oil has shown good effectiveness in control of microbial biofilm, with a significant reduction of gingival bleeding index<sup>[70]</sup>. There is effectiveness of adjunctive treatment of tea tree oil on the clinical parameters and the level of pentraxin-3 in chronic periodontitis<sup>[73]</sup>. Santamaria et al<sup>[71]</sup> evaluated the antimicrobial effects of tea tree essential oil gel in controlling oral microbial biofilm formation and they established its effectiveness against bacteria. Tea tree oil has the ability to suppress the in vitro production of inflammatory cytokines, suggesting its potential as a therapeutic agent for inflammatory diseases, such as periodontal disease, via modulation of the host response<sup>[72]</sup>.

## Conclusion:

Herbal medicine have been used as an adjuvant in periodontal treatment because they reduce inflammation and act as antioxidant and antibiotics. The usage of herbal products in periodontal treatment has a great potential, but it is a challenge to determine the proper combination of herbal species and their extracts. It is recommended that more researches should be undertaken. Research is needed to deliver these herbal medicine and extracts in more appropriate form like microspheres, chip which can be inserted deep in the pocket. Standardization and quality assurance of these herbal products plays a key role which is to be focused in future and efforts have to be initialized to achieve this target. Further research on nanoparticles, nanoemulsion techniques, which can deliver these extracts in more effective way is to be carried out in future for management of periodontal disease in a natural way.

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