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ROLE OF HERBS IN THE TREATMENT OF PERIODONTAL DISEASES

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ABSTRACT

Oral diseases are major health problems with dental caries and periodontal diseases among the most important preventable global infectious diseases. Periodontitis is a serious gum infection that damages periodontium (the soft tissues and bones present around tooth for support). The disease mainly occurs when bacteria in plaque infect the gums and bones that anchor the teeth. The development of dental caries basically involves acidogenic and aciduric gram-positive bacteria. Most of the treatments in dental carries are aimed at either elimination or suppression of bacteria using antibiotics. Increased resistance of oral bacteria to antibiotics however, has developed keen interest of researcher in herbal treatment. There are number of traditional herbal remedies for the treatment and management of diseases related to teeth, gum and oral hygiene. Hence present review describes the use of plant extracts that inhibit the growth of oral pathogens, reduce the development of biofilms and dental plaque, influence the adhesion of bacteria to surfaces and reduce the symptoms of oral diseases. Active molecules or phytochemicals found in extract are responsible for antibacterial effect.

INTRODUCTION

Periodontal disease is recognized as a major public health problem throughout the world and is the most common cause of tooth loss in adults. Periodontal disease is a general term used to describe several pathological conditions that affect the supporting structures /tissues of teeth. Periodontal treatment aims to cure inflamed tissue, reduce the number of pathogenic bacteria and eliminate the diseased pockets. Mechanical therapy, chemotherapy and systemic administration of antibiotics are some of the clinical methods being utilized currently. Conventional therapy includes scaling – removal of the calculus and the plaque, curettage clearing the inflamed soft tissue, and root planning - removal of necrotic tissues on the root surface. Periodontal diseases are associated with bacterial infections; therefore antibacterial treatment seems to be an appropriate method of improving the condition of the inflamed tissues. One of the major problems associated with conventional treatment of systemic administration of antibiotics is the distribution of drug throughout the body, which is not required and it can also give rise to toxicity problems. One method of minimizing the distribution of therapeutic agents in the body is through the use of local drug delivery system. Many antibacterial are applied directly to the mouth for the treatment of periodontal diseases. Mouth rinses, irrigating solutions and sustained release devices are some of the local delivery systems[16].

Herbal medicine is an increasingly common form of alternative therapy throughout the world. Consequently, herbal medicines are finding their more and more usefulness in the arena of dentistry and their armamentarium. Herbal extracts are effective because they interact with specific chemical receptors within the body. Herbal medicines have less side-effect in comparison with traditional medicines, but side-effects do occur and are safer to use than conventional medications[2]. There are many natural ways to treat periodontal disease some of which even help in preventing it from occurring. There are a number of herbs that can help eliminate inflammation and infection associated with periodontal diseases. Use of herbal extracts in the form of dentifrice, medicated gel, local drug delivery systems proved to be efficient in preventing and treating periodontal disease.

Herbal products can vary in their potency. Therefore, care must be taken in their selection. The biggest challenge and problem is the lack of information about the effect of herbs on oral tissues, mechanism of action and side-effects. Herbal medicines have two special characteristics that distinguish them from chemical drugs; use of crude herbs and prolonged usage. Experience has shown that there are real benefits in the long-term use of whole

medicinal plants and their extracts, since the constituents in them work in conjunction with each other[1]. Several popular conventional drugs on the market are from various herbs. Natural products have been used for thousands of years in folk medicine and they are believed to be the new source of antimicrobial agents.

Earlier they were limited to as an important ingredient of tooth pastes, mouthwashes and as pain reliever, but now a days they are increasingly being used in all possible treatments in dentistry like root canals, surgeries, periodontal therapies, anti-plaque agents to name a few. Herbs have been used for centuries to prevent and control dental disease. It is well documented that medicinal plants confer considerable antibacterial activity against various microorganisms including bacteria's responsible for dental caries. Phytochemicals for the prevention, treatment and maintenance of periodontal diseases are identified. They may be tannins, terpenoids, flavanoids, alkaloids, polyphenols etc. Antimicrobial activities of these have been found to be particularly useful for periodontal diseases[3]. The biggest challenge and problem is the lack of information about the effect of herbs on oral tissues, mechanism of action, and side effects. There are many natural ways to treat periodontal disease some of which even help in preventing it from occurring. There are a number of herbs that can help eliminate inflammation and infection associated with periodontal diseases.

The herbs described in this article are Aloe vera, Bloodroot, Caraway, Chamomile, Clove, Cranberry, Evening Primrose, Garlic, Ginger, Green Tea, Haritaki, Liquorice, Myrrh, Neem, Peppermint, Propolis, Purple Coneflower, Rosemary, Sage, Thyme, Turmeric, Tulsi, Triphala, and a summary of other herbs that are useful in dentistry. Hence the present review has been undertaken to study the effect of various herbs that are useful in dentistry.

Herbal remedies

Periodontal diseases are common in today's society. These are usually progressive disorders affecting the gums and underlying bone structure. Gum diseases can be successfully treated with herbs. Symptoms of gum disease include red, swollen gums that bleed easily, chronic bad breath, loose or shifting teeth, receding gums, loss of teeth, changes in bite pattern, and hot and cold sensitivity. If gum disease is diagnosed, rub the gums with fresh strawberries, baking soda, sage leaves, honey, or lemon juice. St. John's Wort, peppermint, chamomile, or ginseng can also help. To control infection and stop bleeding use a yellow root and myrrh powder poultice and apply directly to gum area. Other remedies include diluted tea tree oil, witch hazel, licorice root extract, calendula extract, aloe vera juice, turmeric, green drinks (containing chlorophyll), cranberry juice, Echinacea extract, propolis tincture, diluted clove

oil, diluted eucalyptus oil, or grapefruit seed extract[30-33]. There are toothpastes on the market that contain tea tree oil and myrrh. Both are excellent remedies for gum disease. Another option is to buy powdered myrrh from a health food store and sprinkle some on toothpaste before brushing. The taste is bitter but can help save teeth. Use daily to heal the gums and weekly to protect them. Brushing after every meal is recommended. Everyone should brush at least twice a day but not so often that gums are irritated. Flossing is also very important to mouth and gum health. Replace your toothbrush every 3 months and make sure the bristles are not too hard or they may injure your gums. Rinsing with salt water can also help keep gums healthy. Sometimes dietary supplements are needed to protect and heal the gums. Minerals such as calcium, vitamins (especially vitamin C and vitamin E), and antioxidants like CoQ10 are often taken to promote gum health[34].

Benefits of herbal drugs:

- Herbal drugs have long era of use and better patient tolerance as well as public acceptance.
- Herbal drugs acts as a renewable source, which is our only hope for sustainable supplies of cheaper medicines for the worlds growing population.
- Availability of medicinal plants is not a problem especially in developing countries like India having rich agro-climatic, cultural and ethnic biodiversity.
- The cultivation and processing of medicinal herbs and herbal products is environment-friendly.
- Throughout the world, herbal medicine has provided many of the most useful and vast variety of drugs to the modern medical science[44].

PLANT EXTRACT AGAINST ORAL BACTERIA

Several studies have demonstrated the antibacterial effect of plant extracts against oral bacteria. Extracts of green tea inhibited the growth of *S. mutansin vitro* (Sakanaka et al. 1989) and prevented its attachment to tooth enamel by inhibiting glucosyltransferase activity. These activities were probably due to the presence of catechins. Oolong tea extracts inhibited experimental dental caries in specific pathogen free rats infected with mutans, streptococci and reduced dental plaque formation in humans. Various Chinese medicines rich in tannins, extracts of cocoa, coffee, hops and propanone extracts of bark also inhibited GTA. Aqueous extracts of various African plants inhibited attachment of *S. mutans*to glass or hydroxyapatite beads. Extracts of cocoa bean husk have been shown to be cariostatic. *Rosmarinus officianalis* L. and *Salvia officianalis* L. have been widely studied for their antimicrobial activity. *R. officianalis L.* extracts have been shown to inhibit growth and GTA production in *Streptococcus sobrinus.* Shi *et al.* (2003) developed compositions of herbs and methods of using these compositions for the treatment and prevention of microbial infection, in particular

for dental caries or periodontal disease. The composition consisted of mixture of any two or more herbs such as *Phellodendron amurense, Paris polyphylla , Prunus mume, Glycyrrhiza uralensis, Aframomum villosum, Sanguisorba officinalis, Elsholtzia splendens, Eugenia caryophyllata, Rhus chinensis, Atractylodes chinensis* Koidz, *Perilla frutescens , Coptis chinensis, Sophora flavescens, Bletilla striata , Aframomum cardamomum, Sophora tonkinensis, Melia toosendan,* and Medicinal rhubarb root. The authors conducted evaluation of the herbal formula using human cell lines and Ame's DNA mutagenesis tests and found the formulation to be safe[27].

ESSENTIAL OILS WITH ACTIVITY AGAINST ORAL BACTERIA

The antibacterial properties of essential oils are well-known and activity against bacteria found in the oral cavity, including pathogens, has been documented. Indeed, there is evidence that commercial mouthwashes containing essential oils are useful in the long-term control of plaque and mild-to-moderate gingivitis and are preferred to those containing chlorhexidine for long-term daily use. A number of recent studies add to the evidence that essential oils may be suitable additives in products used for the maintenance of oral hygiene or prevention of dental disease. The essential oil of *Melaleuca alternifolia* (Myrtaceae), known as tea tree oil (TTO), has been used medicinally for many years. TTO has antimicrobial properties and is used in the superficial treatment of skin infections. The activity of TTO against an extensive collection of oral bacterial isolates was investigated by Hammer *et al*. who determined MIC and MBC values in the range 0.003–2.0% (v/v). Further, time-kill assays showed that exposure of *S. mutans* and *Lactobacillus rhamnosus* to 0.5% (v/v) TTO resulted in >3 log reduction of viable cells within 30s. The activity of TTO against oral pathogens was supported in a study involving this and other essential oils, including manuka oil, eucalyptus oil, lavandula oil and rosmarinus oil. In addition to their inhibitory and bactericidal activities, most of the oils were able to inhibit the adhesion of *S. mutans* and *P. gingivalis*. Essential oils are also capable of enhancing the activity of chlorhexidine.

When used in combination, the essential oils of cinnamon and manuka were able to significantly reduce the amount of chlorhexidine required to inhibit the growth of oral pathogens. This enhanced activity was also seen against bacterial cultures grown as biofilms. Between 4- and 10-fold reductions of the amount of chlorhexidine required to inhibit biofilm bacteria was observed when used in combination with cinnamon, manuka and *Leptospermum morrisonii* oils. The essential oils of *Artemisia lavandulaefolia* (Asteraceae), *A. capillaries, A. scoparia* and *A. feddei* have been shown to inhibit the growth of oral, with the greatest

activity generally observed against obligate anaerobes. However, the oils also showed strong activity against other groups, including facultative anaerobes and microaerophilic bacteria. A recent study reported that the essential oil of *Cryptomeria japonica* (Taxodiaceae) exhibited strong activity against all bacteria tested, especially oral bacteria, with MIC of 0.025–0.5mgmL−1. While these *in vitro* results are very encouraging, the known toxicity of TTO when ingested suggests that further studies of the safety of this and other essential oils for use in the oral cavity need to be addressed. In this context, Takarada et al. showed that the essential oils used in their study had little effect on human umbilical vein endothelial cells *in vitro* when tested at a concentration of 0.2% (v/v), well within the MIC and MBC values of several oils against some of the bacteria tested.

MODE OF ACTION: Those botanical which contain phenolic compounds have anti-inflammatory and prostaglandin synthetase-inhibiting activity. In a neutrophil chemotaxis assay, Azuma et al. demonstrated that phenolic compounds act as scavengers of free oxygen radicals and, hence, affect leukocyte activity. Further, in an in vitro study, Firatli et al showed that the antioxidative effect of essential oil mouth wash expressed as the percentage inhibition of spontaneous oxidation was greater than that of chlorhexidine[42, 43].

HERBS IN DENTISTRY

***Acacia catechu* willd**

Acacia catechu willd (AC) is widely used in the treatment of skin diseases. It is not only useful in the treatment of diarrhoea, dysentery, colitis and gastric cancer but also in the treatment of mouth, gum and throat diseases like gingivitis and stomatitis. Catechin is used as a haemostatic and taxifolin has anti-bacterial, anti-fungal, anti-inflammatory and antioxidant properties.

Uses of AC in the management of periodontal disease:

A composition of AC powder (91%), Menthol (2.7%) and Camphor (6.3%) removes plaque, stain or patches and cleans and polishes tooth surface without an abrasive action. The powder of AC is used for cleaning and polishing tooth surface without an abrasive action whereas powder of menthol and camphor is used as a flavouring agent. A clinical study on this dentifrice tooth powder reported 87-95%, 70-72% and 80-95% reductions in plaque, gingivitis and dental calculus respectively, in about 15 days of treatment[32].

Aloe vera

Aloe vera is a cactus plant that belongs to the Liliaceae family. More than 300 species of aloe plants exist. In recent years, various cosmetic and medical products are made from the

mucilaginous tissue present in the center of the Aloe vera leaf in the form of Aloe vera gel. The sub lingual administration of aloe vera extract is reported to be efficient in treating periodontitis[22, 23].

• The chemical constituents in Aloe vera are anthraquinones, saccharides, prostaglandins and fatty acids. Others: enzymes, amino acids, vitamins, minerals. Other compounds: Cholesterol, triglycerides, steroids, uric acid, lignins, beta-sitosterol, gibberellin, salicylic acid.

• It is analgesic, antibacterial, antiviral, antifungal, antioxidant immune modulating, antiseptic, anti-inflammatory. Aloe vera is used in the sites of periodontal surgery, toothpick injuries, chemical burns, aphthous ulcers, gum abscesses, dry socket, lichen planus, benign pemphigus and gingival problems associated with AIDS, leukemia, migratory glossitis, geographic tongue and burning mouth syndrome, denture sore mouth, candidiasis, desquamative gingivitis, vesiculobullous diseases, acute monocytic leukemia, xerostomia. Studies have shown it might lead to allergic reactions: generalized eczematous and popular dermatitis (from topical application)[2, 4-7].

Uses of Aloe vera in the management of periodontal diseases:

A composition of olive oil extract, black walnut green hulls, clove leaf, thyme herb, grapefruit seed extract, chamomile flower, green tea leaf, Oregano leaf, peppermint oil, aloe vera, calendula flower, Echinacea purpura, gota kola extract, Cinnamon bark, Eucalyptus leaf, Lavender oil, etc was effective in preventing and treating oral diseases and maintaining good oral health. This composition provided a permanent solution for oral disorders like gingivitis, periodontal disease, stomatitis and halitosis. Build-up of tartar on teeth is prevented and it suppresses oral and throat cancer. The composition may be in the form of a solution that is diluted before use or in the form of powder that is added to beverages, candies, toothpaste, dental chew, whitening molds etc.

Arctium lappa

This plant has been brought from Japan and acclimated in Brazil, which is widely used in popular medicine all over the world for its well-known therapeutic applications. It has anti-bacterial and antifungal activity, diuretic, anti-oxidant and anxiolytic action, anti platelet effect and HIV-inhibitory action[37]. In dentistry, Arctium lappa has been investigated due to its antimicrobial potential against oral microorganisms, specifically those associated with endodontic infections. It has been demonstrated that A. lappa exhibits antimicrobial activity against oral microorganisms and can be used as intra-canal medication for 5 days in teeth infected with *C. albicans, E. coli, L. acidophylus, P. aeruginosa* and *S. mutans* inhibited

microbial growth after 14 days. The microbial inhibition potential of Arctium lappa observed in this study opens perspectives for its use as an intra-canal medication[37].

Areca nut

The herb was proved to contain antibacterial properties against seven Gram-negative anaerobic periodontal pathogens. The effect of areca nut extract and its components arecoline and tannic acid in the presence or absence of nicotine, on common periodontal pathogens was proved in vitro. Its antibacterial activity inhibits the growth of these periodontal pathogens[31].

Black Cohosh (*Rhizoma Cimicifugae*)

The main ingredients are cycloartenol-based triterpenes action, acetylacteone, 26 deoxy acetol, cimidenol, 26-deoxyactein and cimicifugaside. It mainly has an anti-inflammatory effect. Studies have been conducted using its anti-inflammatory property in treating periodontitis, but there is a lack of evidence. It is contraindicated in pregnancy or lactation, or in children under the age of 12 years. Minor gastrointestinal upset and headache are some of the adverse effects of black cohosh.

- Dosage - daily dosage: 40-60% isopropyl alcohol or ethanol extracts of the crude drug corresponding to 40 mg drug[2, 8].

Black pepper (***Piper nigrum)***

Black pepper (aqueous decoction) showed strongest antibacterial activity against different bacterial isolates from oral cavity. Pradeep CR *et al.* showed that piperine has an inhibitory action on nitric oxide production and TNF-α production, both of which have a known role in the pathology of inflammation in periodontal disease. Black pepper contains valuable compounds including Phenolics, various derivatives of lignans, terpenes, chalcones, flavonoid, alkaloid and steroid. Piperine exhibits diverse pharmacological activities like antihypertensive, antioxidant, antitumor, analgesic, anti-inflammatory, hepato-protective, immuno-modulatory, antibacterial, antifungal, insecticidal and larvicidal activities etc. Jayashankar et al showed that brushing with a herbal toothpaste with Piper nigrum, Syzyium aromaticum, Zingiber officinale as one of the major components for a period of 12 weeks, showed a significant reduction in the gingival bleeding.

Bloodroot (*Sanguinaria canadensis*)

It is a perennial, herbaceous flowering plant native to eastern North America. Sanguinaria canadensis is also known as bloodwort, red puccoon root, and sometimes pauson. The principal chemical constituent is sanguinarine. It has antibacterial, anti-inflammatory, antifungal property. Mainly used for gingivitis and periodontal disease, remineralization of

enamel lesions, acute sore throat. It is considered unsafe for use in children and pregnant or lactating women. Long-term use might lead to nausea and vomiting, glaucoma, oedema, heart disease, miscarriage, diarrhoea, stomach pain, visual changes, and paralysis[2, 5]. Bloodroot produces benzylisoquinoline alkaloids, primarily the toxin sanguinarine. The alkaloids are transported to and stored in the rhizome.

Mary P. Cullinan, in his study investigated the efficacy of a Sanguinaria containing oral rinse and dentifrice as an adjunct to self-performed plaque control during the initial therapy phase of periodontal treatment. The initial therapy is to reduce marginal inflammation so as to allow residual disease to be assessed and treated. As supragingival plaque control, in conjunction with supragingival and subgingival scaling, is necessary to reduce marginal inflammation, an effective anti-plaque agent may be a beneficial adjunct in early stages of therapy whilst a patient is developing effective plaque control skills. Chlorhexidine has been shown to be an effective anti-plaque agent. But on prolonged use, it has produced side effects of impaired taste sensation and staining of teeth fillings and tongue. On other side Sanguinaria, does not seem to produce any side effects and has been shown to exhibit anti-microbial activity against plaque microorganisms. Thus, it has been shown to have an inhibitory effect on new plaque formation both in experimental gingivitis model and as a supplement to normal oral hygiene practices. This study showed that use of a Sanguinaria containing dentifrice and oral rinse led to a more rapid resolution of the marginal inflammation in conjunction with initial therapy phase of periodontal treatment.

Caraway (*Carum carvi*)

Caraway contains 3-7% volatile oil, with the main components divided into carvone (50-60%) and limonene (40%). Some of the properties of caraway include antihistaminic, antimicrobial, antiseptic, expectorant, anti-inflammatory, spasmolytic, flavouring agent. Literature has documented its use in gingivitis, periodontal disease, but definite evidence is lacking. Caraway is not used in children under 2 years of age. Some of the adverse effects reported are irritation of the skin and mucous membrane[2].

Chamomile (*Matricaria recutita*)

The Chemical constituents in chamomile are 1-2% volatile oils, essential oil (0.4-1.5%), and chamazulene (1-15%). Other major constituents include α-bisabolol and related sesquiterpenes, flavonoids, apigenin, luteolin, and quercetin. These active ingredients contribute to its anti-inflammatory, antispasmodic, smooth-muscle relaxing action, antibacterial and antiviral activity. Major uses are in gingivitis, periodontal disease and ulcers

as a mouth wash. It usually considered to be safe during pregnancy or breast-feeding. It is not used in people with allergies to plants of the Asteraceae family (ragweed, aster, and chrysanthemums), as well as mugwort pollen. Bronchial constriction with systemic use and allergic skin reactions with topical use[2, 9, 10].

Uses of Chamomile in the management of periodontal diseases[33]:

Chamomile helps to reduce inflammation from periodontitis and also reduces the level of unhealthy bacteria in the mouth. In order to expose the gum to this herb, Chamomile tea is taken or mouth rinses and toothpastes containing Chamomile is taken to overcome periodontal infections.

Cinnamon zeylanicum

Cinnamon oil shows stronger inhibitory activity as measured by minimum inhibitory concentration determination. *Streptococcus mutans*, the etiological agents of dental caries, are highly sensitive to Cinnamon oil and hence it may be used as an antiseptic in toothpaste, mouthwash or chewing gum for prevention of dental caries and other oral infections[45].

***Clove* (*Syzigium aromaticum*)**

The essential oil extracted from the dried flower buds of clove (Myrtaceae) is used as a topical application to relieve pain and to promote healing and also finds use in the fragrance and flavouring industries. The main constituents of the essential oil are phenylpropanoids such as carvacrol, thymol, eugenol and cinnamaldehyde. Clove oil also consists of essential oil, eugenol, eugenol acetate and β-caryophyllene. The biological activity of *Eugenia caryophyllata* has been investigated on several microorganisms and parasites, including pathogenic bacteria, *Herpes simplex* and hepatitis C viruses. In addition to its analgesic, antimicrobial, antioxidant, antifungal and antiviral activity, clove essential oil possesses anti-inflammatory, cytotoxic, insect repellent and anaesthetic properties[26].

- It has been used to relieve toothache, in periodontitis, as an anesthetic and also to treat bleeding gums.
- Use with caution in children, pregnant and lactating women. Allergic contact dermatitis on topical use.
- It is available as a tincture (1:5, 25% ethanol), lozenges and mouthwash[7, 9, 11].

In dentistry, clove oil is applied in an undiluted form using a plug of cotton wool soaked in the oil and applied to the cavity of the tooth[40]. A study by Cai *et al.* (1996) reported preferential activity of crude methanolic extract of clove against Gram-negative anaerobic oral pathogens which cause periodontal diseases[41]. This study included isolation of eight

active constituents and the antibacterial effect of these isolated compounds were studied. The authors reported kaempferol and myricetin to have significant growth inhibitory effect against periodontal pathogens.

Coconut Water (*Cocos Nucifera*)

The name coconut comes from Spanish and Portugese word coco, which means "monkey face." Coconuts are the fruit of the coconut palm, botanically known as Cocos Nucifera, with nucifera meaning "Nut-bearing." In Sanskrit, the coconut palm is known as Kalpa Vriksha, meaning "tree which gives all that is necessary for living," since nearly all parts of the tree can be used in some manner or another.

Coconut water's unique nutritional profile makes an excellent oral rehydration, enhances immune function, possesses anti-aging properties, decreased swelling, relieve spasm, root canal irrigant (antiviral, antifungal and antimicrobial properties) and storage media for avulsed tooth[22]. A new storage media, coconut water, in maintaining viable periodontal ligament (PDL) cells on avulsed teeth, may be better alternative to Hank's Balanced Salt Solution or milk in terms of maintaining PDL cell viability after avulsion and storage[23, 24]. Coconut water is easily available in most of countries, and more importantly, it is a natural transport medium that is sterile and inexpensive.

Cranberry

Cranberries contain numerous biologically active compounds including flavonoids, phenolic acids, anthocyanins, condensed tannins, and other components presence of antioxidants flavonoids thought to have antimicrobial activity[25]. Researchers from the University of Rochester School of Medicine and Dentistry, and Rutgers University, New York, found that many of these substances can not only inhibit the enzymes associated with the formation of the dental plaque polysaccharide matrix film, but can stop the bacteria sticking to surfaces, ensuring that plaque is never given the chance to form. The compounds also prevent acid formation and reduce the acid tolerance of the bacteria that cause decay hence preventing prevent tooth decay and gum disease. However, these findings should be treated with a degree of caution because Cranberry juice is naturally very acidic and can cause erosion of teeth if taken too often. This can lead to pain and sensitivity in the teeth[26, 28]. Because of its antiadhesive property it can used in dental caries, periodontal disease, oral squamous cell carcinoma. There is no evidence of contraindications and adverse effects[2, 11-14].

Dandelion (*Taraxacum officinale*) Dandelion has anti-inflammatory, analgesic, antiulcer, antimicrobial property that makes it useful in periodontitis. Contraindications are those with

obstruction of the biliary or intestinal tract and acute gallbladder inflammation. It cause minor gastrointestinal upset and headache on long term usage.

Elderberry (*Sambucus arborescent Gilib*)

Elderberry consists of flavonoids, major secondary metabolites include about 1% triterpenes, 1% sterols, about 3% phenolic acids and their corresponding glycosides, and up to 0.15% essential oil. The anti-inflammatory activity of its constituents has been made and used to treat periodontitis[2, 8, 11].

Eucalyptus oil

Studies suggested that the use of a natural plant extract or essential oils like eucalyptus oil and clove oil either alone or in combination with an anti-microbial compound, a fluoride ion-providing compound, analgesic enzyme etc. 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[27].

Evening Primrose (*Oleum oenothera biennis*)

The chemical constituents primrose are linoleic acid (*cis*-linoleic acid) (65-80%), g-linolenic, acid (*cis*-g-linolenic acid) (8-14%), oleic acid (6-11%), palmitic acid (7-10%) and stearic acid (1.5-3.5%). Other constituents include sterols and triterpene alcohols. These have antiallergic activity, antiulcer activity. Used in orthodontic tooth movement and dental caries. Some of the adverse effects are headaches, nausea, loose stools and diarrhoea. Administration of the fixed oil precipitated symptoms of undiagnosed temporal lobe epilepsy in schizophrenic patients taking phenothiazine[2, 8].

Garlic (*Allium sativum*)

Garlic consists of alliin, ajoene, diallyl sulfide, dithiin, S-acetylcysteine, and enzymes, B vitamins, proteins, minerals. It has got antibacterial, antiviral, and antifungal, antiseptic, bacteriostatic, antihelminthic effects. Studies have been done using garlic to treat dental caries and periodontitis. Reports have shown adverse effects such as allergic reactions such as contact dermatitis and asthmatic attacks, increased bacterial attachment to orthodontic wires[2, 4, 9, 11].

Ginger (*Zingiber officinalis*)

The various components of ginger are 1-4% essential oil and an oleoresin, zingiberene, curcumin, sesqui-phellandrene, bisabolene. Monoterpene aldehydes and alcohols are also present. It has antibacterial, anti-inflammatory, analgesic property. It is used to relieve

toothache, as a sialogog, in the treatment of oral thrush. Ginger may reduce the toxic effects of the chemotherapeutic agent cyclophosphamide. It should not be used in pregnancy and patients with the biliary disease. Because ginger can interfere with blood clotting, it should be used cautiously in patients on anticoagulant therapies such as coumadin or heparin[4, 10, 11].

Ginseng (Radix Ginseng)

Chemical constituents of ginseng include triterpene, saponins, oleanolic acid. It is anthelminthic, analgesic, antispasmodic, antimicrobial, anti-inflammatory, antipyretic, immuno stimulatory, antiulcer property and used in periodontitis. Adverse effects with its use are hypertension, nervousness, irritability, diarrhoea, skin eruptions, and insomnia[2,4, 11, 12, 15].

Goldenseal (Rhizoma Hydrastis)

Chemical constituents present are isoquinoline alkaloids principally hydrastine, followed by berberine, canadine and lesser quantities of related alkaloids including Canada line, coalmine, hydrastine and jatrorrhizine. It has got anti-inflammatory and hemostatic property and used in periodontitis. Goldenseal contraindications include those with obstruction of the biliary or intestinal tract and acute gallbladder inflammation. Long term usage might result in exaggerated reflexes, convulsions, paralysis and death from respiratory failure[2,11,16].

Grape Seed Extract

Grape seed extract contains proanthocyanidins (PA) which are potent antioxidants and are known to possess anti-inflammatory, antibacterial and immune-stimulating effects. It has been reported to strengthen collagen based tissues by increasing collagen cross-links[39]. In a study conducted to determine re-mineralizing effects of grape seed extract on artificial root caries, results showed that is a promising natural agent for non-invasive root caries therapy[39, 40].

Green Tea (*Camellia sinensis*)

It is made from the leaves of *Camellia sinensis* that have undergone minimal *oxidation during processing*. Green tea originates in *China*. Green tea extract is approximately twice more antioxidant-active than *Vitamin C*. The cardinal antioxidative ingredient in the green tea extract is green tea catechins (GTC), which comprise four major epicatechin derivatives; namely, epicatechin (EC), *epigallocatechin* (EGC), *epicatechin gallate* (ECG), and *epigallocatechin gallate* (EGCG). It is anti-inflammatory, antibacterial, and antiviral. Used in the treatment of periodontal disease[9, 14, 16, 18]. Narotzki B, in his review about effect of Green tea on oral health showed that Green tea protects against bacterial induced dental caries. Green tea polyphenols can abolish halitosis through modification of odorant sulphur

components. Oral cavity oxidative stress and inflammation, consequent to cigarette smoking and cigarettes deleterious compounds nicotine and acrolein, may be reduced in the presence of Green tea polyphenols. It also defends healthy cells from malignant transformation and locally has the ability to induce apoptosis in oral cancer cells. Extracts of green tea inhibited the growth of *S. mutansin* vitro (Sakanaka et al. 1989) and prevented its attachment to tooth enamel by inhibiting glucosyltransferase activity. These activities were probably due to the presence of catechins.

Haritaki (*Terminalia chebula*)

The chemical constituents of triphala consist of tannins, chebulaic acid, chebulinic acid, cerulenin, corilagin, gallic acid, gallic acid methyl ester, punicalagin, terchebulin and terminalic acid. Flavonols of interest include quercetin, isoquercitrin and rutin. It has antioxidant, antimicrobial, antihelminthic, astringent, dentifrice, anti- inflammatory. Studies have indicated it can be effectively used in the treatment of dental caries, bleeding and ulcerated gums. Contraindicated in children under 12 years, pregnant and lactating women.

• Daily dosage: 3-9 g of crude drug for decoction in divided doses[13].

***Kaempferia pandurata* Roxb**

Kaempferia pandurata Roxb which is an edible tropical medicinal plant (Zingiberaceae), has been traditionally used to treat dental caries. It is efficient in inhibition of matrix metalloproteinase (MMP)-9 for preventing periodontal inflammation[29].

Liquorice (*Glycyrrhiza glabra*)

Major components in liquorice are triterpene saponins, glycyrrhizin (is the major component (2-9%); minor components occur in proportions that vary depending on the species and geographical location. Glycyrrhizin occurs as a mixture of potassium and calcium salts. Flavonoid constituents include liquiritigenin and isoliquiritigenin. It had antimicrobial, anti-inflammatory and antiviral activity and used in dental caries. Contraindicated in patients with hypertension, cholestatic disorders or cirrhosis of the liver, hypokalemia, or chronic renal insufficiency, and during pregnancy. Some of the adverse effects reported are pseudo aldosteronism, which includes potassium depletion, sodium retention, edema, hypertension, and weight gain[5].

Uses of liquorice root in the management of periodontal diseases[37]:

Moon et al described the use of plant extract powder in oral formulations for the prevention and treatment of periodontal diseases and tooth decay. The plant extract was loaded into a porous powder carrier that was coated with a water insoluble coating material. The extract

contained Pine, Liquorice, Cassia seed, Cinnamon, Nothosmyrnium root, sophora, lonicera flower, platycodon, green tea, day flower, Korean angelica root, liriope rhizome, moutan, Arabian myrrh, seseleos radix, Angelicae Dahuricae Radix, Lagersromemia indica, morusk, ginger, Sanguinaria, Asaram, Cimicifuga, Chinese galls, Grapefruit seed, Lycium root, Cnidium, Alpinia katsumadai Hayata, Gardenia, Lythrum salicaria L, dandelion, propolis, falvanoid, nepta herb, Reynoturia japonica Houtt, scutelleria, machilia, black adzuki bean, chamomile, ratanhia or sage oil as single or in combination. The water insoluble coating easily disintegrated in the oral cavity and the active ingredients are released. The composition may be formulated as toothpaste, oral cleaner, oral purifier, etc[38]. 18-beta-glycyrrhetinic acid (GA) is an anti-inflammatory compound extracted from liquorice root extract. There was a dramatical reduction in the infection-induced bone loss in IL-10 deficient mice when GA was administered prophylactically or therapeutically. Initially GA was thought to exert its anti-inflammatory activity through down regulation of 11-beta hydroxy steroid dehydrogenase-2 (HSD2). HSD2 converts active glucocorticoid to inactive forms. But, GA did not reduce HSD2 expression in gingival tissue. GA inhibits periodontitis by inactivation of NF.

Mangosteen (***Garcinia Mangostana L*****)**

Mangostana, colloquially known simply as mangosteen, is a tropical evergreen tree believed to have originated in the Sunda Islands and the Moluccas of Indonesia. Mangosteen peel contains xanthonoids, such as mangostin, and other phytochemicals having antioxidant properties in vitro. Rassameemasmaung S did a study based on 60 subjects who were diagnosed as having mild or moderate chronic gingivitis to determine the effects of herbal mouthwash containing the pericarp extract of Garcinia mangostana L on halitosisand plaque. The result showed that herbal mouthwash containing pericarp extract of Garcinia mangostana was useful in improvement of plaque index and it may be used as an adjunct in treating oral malodor.

Mastic gum (Isle of Chios)

Use of mastic gum (Isle of Chios) in alone or in combination with antimicrobials like metronidazole, Keflex, amoxicillin, tetracycline, clarithromycin, bismuth is found to be efficient for treating the cause of a diagnosed non-gastric disease such as periodontal disease and gingivitis. Mastic gum might be helpful in maintenance therapy. The therapy could extend up to 120 days[30].

Meswak (*Salvadora persica*) It is known as Arak, Galenia asiatica, Meswak, Peelu, Pīlu, Salvadora indica, or toothbrush tree, mustard tree, is a species of Salvadora. Research

suggests that it contains a number of medically beneficial properties including abrasives, antiseptics, astringent, detergents, *enzyme inhibitors* and *fluoride*. According to chemical and phytochemical analysis of Salvadora persica, there was an occurrence of carbohydrates and/or trimethylamine; an alkaloid which may effectively be salvadorine; chlorides; sulfur; terpenes; vitamin C; glycosides; large amounts of fluoride and silica; small amounts of tannins, saponins, flavonoids and sterols. Puneet gupta conducted a study to evaluate the anti-plaque efficacy of Meswak (Salvadora persica) containing dentifrice. The result showed that there were significant differences in the reduction of plaque by it. The study was done using a randomized, triple blind parallel design method. Meswak mainly grows in Saudi Arabia but also in other parts of Middle East. Meswak is a chewing stick used by many people in different cultures and in many developing countries as a traditional tooth brush for oral hygiene. These results were consistent with those reported by Batwa et al. Thus, through this study it was seen that Meswak extracts have both anti- plaque and anti-gingivitis action. Khalessi AM did an in vivo study of plaque control efficacy of persica mouthwash (containing an extract of Salvadora persica). The use of persica resulted in significant reduction in carriage rate of cariogenic bacteria mutans Streptococci (MS) in saliva and reduced gingival bleeding ($p<0.01$). There was gingival health improvement but reduction in accumulation of dental plaque was not observed in this study.

Myrrh (Commiphora molm)

The three main constituents of myrrh are the resin, the gum, and the volatile oil. The gum consists of 20% proteins and 65% carbohydrates made up of galactose, 4-*O*-methylglucuronic acid and arabinose. Myrrh had been used in pharyngitis, tonsillitis, gingivitis, stomatitis and ulcers. Topical application for the treatment of and for local application as an anodyne to treat infections of the oral cavity. It should not be used in pregnancy. Adverse effects include contact dermatitis[2, 11, 17].

Neem (*Azadirachta indica*)

Azadirachta Indica (Neem) is proved to be efficient in treating patients with chronic periodontitis. It acts by the removal or inhibition of subgingival plaque and maintenance is dependent on continued plaque control for which adjunctive local antimicrobial therapy has shown promising results[24]. Neem consists of genin, sodium nimbinate, salannin, nimbin, azadirachtin, nimbidiol, quercetin and nimbidin. Neem leaves contain fiber, carbohydrates and at least 10 amino acid proteins, calcium, carotenoids, fluoride. Neem has antiviral, antifungal, antimicrobial, antibacterial, antipyretic, anti-inflammatory, antitumor, analgesic,

anthelminthic, anticariogenic, antioxidant activity. Studies have shown that neem is used in the treatment of dental caries, gingivitis, and periodontitis.

- Dosage - Infusion (1:20): 15-30 ml; Tincture (1:5): 4-8 ml. External applications: 70% ethanol extract of the leaves diluted to 40%, apply twice daily[8, 13, 19].

Uses of Neem leaf extract in the management of periodontal diseases:

People residing in the villages of India use Neem twigs to brush their teeth in order keep their gum free of disease and infection. A study shows that Neem leaf extract is used to treat dental plaque and gingivitis[34]. Micro-organisms found in inflamed gum are resistant to tetracycline and penicillin but not to the neem leaf extracts. Also neem leaf extracts cause no allergic reaction in the gingiva[35]. Advanced gum disease characterized by an inflammation of the gums and the membranes covering the roots of the teeth is known as pyorrhoea. When this condition was treated with neem-based toothpaste and mouthwash, the bleeding gums healed, the secretion from pockets around the teeth ceased and the blue-tinted gums returned to healthy pale pink colour[36]. The herbal formulation comprising of active fractions from Azadirachta indica, Citrullus colocynthis and Cucumis sativus is useful for preventing dental plaque and gingivitis in humans and is also used as an antimicrobial agent for preventing disease.

Piper betel

Piper betel Linn (Piperaceae) leaves is widely used as a post meal mouth freshener. Leaves extract contains large numbers of bioactive molecules like polyphenols, alkaloids, steroids, saponins and tannins. It is well documented that flavonoids are the polyphenolic compounds which showed potential beneficial effects on human health and possess antibacterial, antiviral, anti-inflammatory, antitumor, antihaemolytic and antioxidative activity. In Indian folkloric medicine, betel leaf is popular as an antiseptic and is commonly applied on wounds and lesions for its healing effects. The bioactive molecule thought to be responsible for antibacterial activity is sterol which has been obtained in large quantities in *Piper betel* extracts.

Peppermint (*Mentha piperita*)

- Peppermint leaves yield approximately 0.1-1.0% volatile oil that is composed primarily of menthol (29-48%) and menthone (20-31%).
- It is analgesic and also has muscle-relaxing action. Peppermint oil application for toothache by soaking a cotton ball in the oil and placing it in the cavity or rubbing it on the tooth.

• Avoided by people with severe liver damage, inflammation of the gallbladder or obstruction of bile ducts. Adverse effects reported are burning and gastrointestinal upset, skin rashes, headache, heartburn, bradycardia, muscle tremors and ataxia[2, 5, 8, 11].

Periwinkle

Use of dried ethanolic extract of periwinkle (*Vincarosea*) in the oral cavity as a method for treatment of periodontal diseases. The formulation contained 0.03 - 50% w/w of the extract. A carrier such as water, glycerin and lower alcohols could be used for the extracts. The composition could be oral rinse or toothpaste and may include anionic surface active agents such as sodium lauryl sulfate. The ethanolic extract was reported to possess enhanced antimicrobial action with sodium lauryl sulphate[28].

Pomegranate (*Punica granatum*)

It is a fruit-bearing deciduous shrub or small tree. The pomegranate is widely considered to have originated in the vicinity of Iran and has been cultivated since ancient times. Active ingredients of pomegranate ellagic acid, total polyphenols C. Ashwini Somu did a clinical study to evaluate the anti–gingivitis effect of a gel containing Pomegranate extract using 21 – day trial in patients with chronic gingivitis. The result showed that the Pomegranate gel when used as an adjunct with mechanical debridement was efficient in treating gingivitis. This study showed significant reduction in plaque score and gingivitis. These results are consistent with those reported by Pereira and Sampanio who showed a significant reduction in gingivitis using the dentifrice containing pomegranate extract.

Propolis

Propolis is a complex mixture made up of plant-derived and bee released compounds. Raw propolis consists of around 50% resins, 30% waxes, 10% essential oils, 5% pollen and 5% of various organic compounds. Caffeic acid phenanthryl ester, polyisoprenylated benzophenone, galangal, pino banksin and pino cembrin, amino acids, phenolic acids, phenolic acid esters, flavonoids, cinnamic acid, terpenes. It has got a wide range of activity as anesthetics, antibacterial, antifungal, antiviral (including anti- HIV-1 activity), antioxidant, anticarcinogenic, antimutagenic, antithrombotic and immunomodulatory. It has been used in dental caries, gingivitis, storage medium, intracanal medicament, dentinal hypersensitivity, relief from denture ulceration, stomatitis, halitosis, mouth freshener, periodontal pocket/abscess, dentinal sensitivity, lichen planus, candidal infections, angular cheilitis, xerostomia, traumatic ulcers, pulp capping, temporary restorations and dressings, covering tooth preparations, dry socket, pre-anesthetic, and pericoronitis[2, 9, 13, 18-20].

Purple Coneflower (Echinacea)

It consists of alkyl amide/ polyacetylenes, caffeic acid derivatives, and polysaccharides. The mouthwash of Echinacea is effective in gingivitis and periodontal disease in combination with sage, peppermint oil, menthol and chamomile. It contraindicated in serious conditions such as tuberculosis, leukosis, collagenous, multiple sclerosis, AIDS, HIV infection and autoimmune disorders. It might lead to allergic reactions[2, 4, 20, 22].

Rosemary (*Rosmarinus officinalis*)

Chemical constituents of rosemary includes volatile oil, carnosol, ursolic, linalyl acetate (25-46%), linalool (20-45%), lavendulyl acetate (>1.0%), 1,8-cineole, eucalyptol (<2.5%), 3-octanone (<2.5%), camphor (<1.2%), limonene (<1.0%), and α-terpineol (<2.0%). It has antibacterial, antifungal, antioxidant, anti-inflammatory property. It used in relieving toothache, disinfecting GP cones and contraindicated in pregnant and lactating women. Dosage - Tea can be taken several times per day. Rosemary tincture, half to one teaspoon (2-5 ml) three times per day, may also be used[2, 11, 18].

Sage (*Salvia officinalis*)

The volatile oil of sage contains the constituent alpha and beta-thujone, camphor, and cineole. It also contains rosmarinic acid, tannins and flavonoids. It is used in treatment of sore throat, inflammations in the mouth, and gingivitis. Sage oil has antibacterial, antifungal, and antiviral activity that may partially explain the effectiveness of sage for this indication. It not used in pregnant women, children, should be avoided when fever is present. Adverse effects include increased heart rate and mental confusion. Very high amounts may lead to convulsions[2, 11].

Tea Tree Oil (*Melaleuca alternifolia*)

It is more commonly known Australian tea tree oil as, is a native Australian plant with many properties such as being an antiseptic, an antifungal agent and a mild solvent. Tea tree oil's major active component is terpinen-4-ol (30%–40%). This compound is responsible for its antibacterial and antifungal properties[8]. In dentistry, tea tree oil has been used to destroy microorganisms in the mouth before dental surgery, removal of smear layer when used as a root canal irrigant and to relieve mouth soreness caused by dental procedures[9, 12]. In studies of patients who suffered from oral candidiasis mouth rinses containing tea tree oil have shown some effectiveness in reducing symptoms when taken in a dose of one table spoonful of 5% tea tree oil solution as a mouth wash that is held in the mouth and then spit out four times a day for up to 4 weeks[13, 14].

Thyme (*Thymus vulgaris*)

The primary constituents are the volatile oils, which include the phenols, thymol and carvacrol. A salve made up of thyme, myrrh, and goldenseal is used to treat oral herpes. Also, thyme is used to treat chronic candidiasis and halitosis. It used with caution in young children, pregnant and lactating mothers. Adverse effects include dizziness, vomiting, and breathing difficulties. Some people may be sensitive to use of thyme oil topically on the skin or as a mouth rinse[2, 4, 5, 13].

Triphala

Triphala is a combination of amalaki, haritaki and bibhitaki. Amalaki contains ascorbic acid, thiamine, riboflavin and niacin. It comprises β-sitosterol, gallic acid, ellagic acid, ethyl gallate, galloyl glucose and chebulagic acid, Haritaki contains chebulagic and chebulinic acid, as well as corilagin. It is antioxidant, antimicrobial. It is used in dental caries, bleeding and ulcerated gums[9].

Tulsi (*Ocimum sanctum*)

In Ayurveda, Tulsi (*Ocimum sanctum L.)* has been well documented for its therapeutic potentials and described as Dashemani Shwasaharni (antiasthmatic) and antikaphic drugs (Kaphaghna). Although, the traditional medical practitioners in India have been widely using this medicinal plant for management of various disease conditions from ancient time[39]. Tulsi consists of tannins (4.6%) and essential oil (up to 2%), eugenol (up to 62%), methyleugenol (up to 86%), and *α*- and β-caryophyllene (up to 42%), methylchavicol, linalool and 1,8-cineole. It has got antihelminthic, analgesic, antipyretic, immune stimulatory, antiulcer, antimicrobial, anti- inflammatory property. It used in periodontitis. Contraindicated in pregnant and lactating women, used with caution in children[8,13].

Turmeric (*Curcuma longa*)

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.

- Chemical constituents of turmeric include volatile oil (6%) composed of a number of monoterpenes and sesquiterpenes, including zingiberene, curcumin, *α*- and β-turmerone among others. The colouring principles (5%) are curcuminoids, 50-60% of which are a mixture of curcumin, mono des methoxy curcumin and bis des methoxy curcumin.
- It is antimutagenic, anticarcinogenic, antioxidant, antibacterial and used in dental caries, oral lichen planus, gingivitis, halitosis, pit and fissure sealant, dental plaque detection

system. Massaging the aching teeth with roasted, ground turmeric eliminates pain and swelling[2, 4, 8, 9, 21].

When dried, turmeric made into a yellow powder with a bitter, slightly acrid, yet sweet taste. In India, it has been used traditionally as a remedy for stomach and liver ailments, as well as topically to heal sores. 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. Research studies proved that a bio-adhesive formulation comprising curcuminoids act as an active agent for treatment and prevention of periodontal disease**.** The composition included curcumin, tetrahydrocurcumin, bishydrocurcumin, crude drug and solvent extracts of *Curcuma longa*, one or more bioadhesive polymers such as hydroxypropyl cellulose, hydroxypropyl methylcellulose, sodium carboxymethylcellulose, hydroxyethylcellulose and carbomers and sodium chloride, sodium bicarbonate or mixtures and one or more excipients. This orally applicable composition can be used for the treatment of periodontal diseases[25].

CONCLUSION

The use of herbal medicine continues to expand rapidly across the world. Many people take herbal medicines or herbal products now for their health care in different national healthcare settings. Herbal extracts have been used in dentistry for reducing inflammation, as antimicrobial plaque agents, for preventing the release of histamine and as antiseptics, antioxidants, antimicrobials, antifungals, antibacterials, antivirals and analgesics. The chemical constituents present in all these herbs like tannins, catechins, taxifolin, terpenoids, flavoinds, and alkaloids are responsible for antimicrobial activity, Hence, they are useful in controlling periodontal diseases. They also aid in healing and are effective in controlling microbial plaque in gingivitis and periodontitis and thereby improving immunity.

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