REVIEW ARTICLE

Herbal Medicines: An Adjunct to Current Treatment Modalities for Periodontal Diseases

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ABSTRACT

Periodontal disease is one of the most common diseases affecting oral health causing alveolar bone loss, tooth loss and bad breath with much prevalence in the age group of 35 – 44 years. Remedies such as toothpastes and mouthwashes are available in the market for its cure however; these are associated with side effects such as tooth staining by chlorhexidine-based mouthwash and altered taste sensation. Excessive use of mouthwashes also alters the normal biological flora of the oral cavity. Therefore, herbal alternatives for the cure of periodontal disease may be of an effective therapeutic significance with less side effects on oral and systemic health. This review summarizes the effective role of herbal medicaments such as *Acacia nilotica* (gum Arabic), *Aloe barbadensis* (Aloe Vera), *Salvadora persica* (Miswak), *Eugenia caryophyllata* (Clove), *Nigella sativa* (Kalonji), *Azadirachta indica* (Neem) and *Propolis resin* (Bee Glue) in the treatment of periodontal disease, thus emphasizing the current need of herbal medicines as better alternatives.

KEYWORDS: Periodontal disease, Herbal medicine, *Aloe barbadensis*, *Salvadora persica*, *Eugenia caryopylata*, *Nigella sativa*, *Azadirachta indica*, *Propolis resin*.

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INTRODUCTION

Periodontal disease is one of the most prevalent multi-factorial, chronic inflammatory process affecting the tooth supporting anatomical structures culminating in tooth loss.[1] The disease begins as a result of certain pathogenic micro-organisms that accumulate and grow sub-gingivally, thus causing tissue destruction and degrading and eliciting a host response.[2] The potential bacteria involved in the progression of the disease are *P.gingivalis, T.forsythensis* and *T.denticola*. *Porphyrpmonas gingivalis.*[3] The fight between the invading bacteria and body's innate response to infection begins to break down the connective tissue and bone that holds teeth in place. If left untreated, the periodontium of the teeth is destroyed. The teeth may eventually lose its attachment to bone and needs to be extracted from the oral cavity.[2,4,5]

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Herbal Medicine: An Alternative

The aim of the treatment of periodontitis is to control the infection by removal of plaque and calculus. The treatment options may range from cost effective non-surgical therapies such as

scaling, root planning and antibiotics to invasive surgical procedures like flap surgeries, guided tissue regeneration (GTR), tissue-stimulating proteins, soft tissue and bone grafts. These mechanical procedures are then supplemented with commercially available at-home remedies such as toothpastes and mouth-rinses.[6,7] But the use of these allopathic products lead to certain adverse effects such as staining of tooth and restorative materials, altered taste sensation, oral mucosal sloughing and drug resistance.[8]

Herbal medicines have been used as traditional medicine for centuries. Although, the advent of newer synthetic drugs has altered dramatically the health care in many regions of the world, the use of herbal medicine still prevails in many populations to fulfill their basic health care needs. In Africa, up to 90% and in India up to 70% of the population rely on traditional herbal medicine for their medical treatment.[9] A herb by definition is any plant that is devoid of woody parts which is an attribute of a shrub or trees.[10] Herbs and plants can be taken in various forms such as whole herb, tea, syrup, extract, ointments, capsules or tablets.[10] Currently, herbal medicines are used for various acute and chronic diseases and numerous ailments. Conditions such as cardiovascular disease, depression, inflammatory disorders and many more have been affectively treated with herbal medicines. Recently, these have been used as immunomodulators in treating severe autoimmune disorders or malignancies as an adjuvant therapy.[11] Herbal extracts have been strongly recommended in dentistry for their anti-plaque and anti-inflammatory properties.[10]A summary of herbs used in treatment of periodontitis is given in Table-1.

Herbs used for Treatment of Periodontitis

i. *Acacia Nilotica* Linn. (*Babool*- Indian Gum Arabic)

Acacia Nilotica Linn, commonly known as Gum Arabic tree, Babool, Egyptian Thorn or Prickly Acacia is a multi-purpose tree legume. It is naturally present in drier areas of Africa, Senegal, Egypt, India and Pakistan.[12] Different parts of the plant like bark, root, gum, pods, and leaves are used for their medicinal properties. It has been used since long for treating malaria, skin, GIT and dental problems. Sore throat has

Table-1: Summary of herbs used in treatment of periodontitis.

Name of Herb	*Common Name*	*Family*	*Parts Used*	*Active Components*	*Phamacological Effects*	*Toxicity*
Acacia Nilotica[52]	Babool-Indian gum Arabic	Fabaceae	Bark, root, gum, pods, leaves	Tannins, phenols, essential oils, flavanoids	Anti-bacterial, Anti-plaque	Low toxicity
Aloe Barbedensis[53, 54]	Aloe vera	Aloaceae	Leaves	Vitamins, minerals, enzymes, polysaccharides, phenols, organic acids	Anti-microbial, Anti-inflammatory	Toxic at high doses only
Salvadora Persica[55, 56]	Chewing stick/Miswak	Salvadoraceae	Roots, twigs, stem	Fluoride, alkaloids, sulphur compounds, glucosinolate, volatile oils (benzylispthiocyanate)	Anti-microbial, anti-plaque	Low toxicity
Eugenia Caprophylatta[57, 58]	Clove	Myrtaceae	Dried flower buds of clove	Eugenol, gallic acid, sesquiterpenes, furfural, flavonoids, kaempfero;, myricetin	Anti-oxidant, Anti-septic, Anti-bacterial, Analgesic, Bacteriostatic	Toxic at low doses in children. Otherwise toxic at high doses
Nigella Sativa[59, 60]	Kalonji/ Black seed	Ranunculaceae	Seeds	Thymoquinone, dothymoquinone, thymohydroquinone, thymol	Anti-oxidant, Anti-inflammatory, Anti-bacterial	Toxic at high doses. Only reported side effect is allergic contact dermatitis
Azadirachta Indica[40, 61]	Neem	Meliaceae	Leaves	Azadirachtin, nimbin, gallic acid, catechin, margolone	Antibacterial, Anti-oxidant, Anti-inflammatory, Host immune-modulatr, Anti-plaque	Low toxicity
Propolis Resin[62]	Bee glu	Variable families of tree	Leaves, flowers, trees, certain barks	Flavanooids, phenols, aromatics, caffeic acid, phenethyl ester	Anti-inflammatory, Anti-bacterial, local anesthetic, Anti-oxidant, Anti-calculus	Allergic reaction reported, otherwise non-toxic

been treated with its aerial part and toothache with the bark.[13] *Babool* possesses antibacterial activity against *S. mutans* and *E. faecalis.*[14] Tender leaves can be used as gargles and topical agents to treat mouth ulcer, throat pain, cleaning mouth, prevent gum bleeding and tighten teeth. Chewing sticks made from its bark have proven to be effective in strengthening of tooth. Antibacterial property is believed to be due to tannins, phenolic compounds, essential oils and flavonoids.[15] A study has shown the inhibitory effect of *A. Nilotica* against plaque pathogens like *S. mutans*, *S. sanguis*, and *S. salivarius* proving its anti-plaque activity.[16]

ii. Aloe Barbadensis (Aloe Vera)

Aloe Barbadensis, also known as Aloe Vera belongs to Lily family cultivated in South Africa, but few species are native to dry sub-tropical and tropical climates such as Southern United States.[17] It is a xerophyte (a plant that is adaptable to low or erratic water availability) with characteristic property of storing large quantity of water. Aloecomprises of green plump leaves covered by a thick cuticle encompassing an inner transparent pulp.[18] The pulp is clear and mucilaginous entity which is the most widely therapeutically used portion of the plant. It is also named as reserve parenchyma and makes up the majority of the leaf by volume.[19] Water content makes up to 99 – 99.5 % of the Aloe Vera plant[20] while rest of 0.5 – 1.0% hard material has been described to contain more than 75 different significantly active compounds. These include water and fat-soluble vitamins, minerals, enzymes, simple and compound polysaccharides, phenolic compounds, and organic acids.[18]

The reserve parenchyma has effective role in cell proliferation and potentiates healing and angiogenesis. Aloe has been proved to be effective against bacteria, fungi and viruses and have anti-inflammatory and anesthetic properties.[17,21] The antimicrobial effects of Aloe Vera have been attributed to the plant's natural anthraquinones: aloe emodin, aloetic acid, aloin, anthracine, anthranol, barbaloin, chrysophanic acid, ethereal oil, ester of cinnamonic acid, isobarbaloin, and resistannol. The antimicrobial properties of aloe are dose-dependent i.e. at low concentration it is effective against microbes while at high doses it could be toxic.[17,21] Aloe Vera used in the form of tooth gel and toothpastes is equally effective against cariogenic and periopathogenic micro-organisms such as *C. albicans, S. mutans, L. acidophilus, P. intermedia and P. anaerobius.* Aloe Vera gel also has an increased anti-bacterial activity against *S. mitis.* It is has also been used for the management of oral lichen planus, dry socket, tooth brush abrasion and oral ulcers.[22]

iii. *Salvodera Persica* (Chewing Sticks or Miswak)

Salvadora persica, L., commonly called miswak belongs to Salvadoraceae family. Miswak or "Chewing sticks" have been used in Muslim communities as an oral hygiene tool since ancient times. Chewing sticks are made from the roots or stems of *S. persica.* It is commonly used in the Middle East for the purpose of oral hygiene maintenance. It contains a number of known antimicrobial and other prophylactic components including fluoride, alkaloids, Sulphur compounds, glucosinolates and volatile oils such as benzylisothiocyanate.[23] It cleans the teeth in two ways: by mechanical scrubbing action of the soft wood fibers, and by therapeutic action of a chemical constituent of the chewing stick itself.[24] It has been proven scientifically that it is effective against tooth decay.[25] Extracts of *S.persica* has demonstrated anti-plaque activity and improved gingival health.

A study comparing commercially available mouth-rinses and 50% miswak extract showed the effective role of miswak in reducing plaque pathogens.[26] World Health Organization (WHO) encourages the use of miswak as a successful oral hygiene tool.[27]

iv. *Eugenia Caophyllata* (Clove)

Another effective herbal medicine used in almost daily routine is *Eugenia Caryophyllata* (Clove). Clove is indigenous to Indonesia, but is

broadly cultivated around the world, including Brazil, Tanzania, Madagascar and Sri Lanka.[28] The essential oil is extracted from the dried flower buds of clove, *Eugenia Cayophyllata* L. Merr. & Perry (Myrtaceae). The chief ingredient of distilled clove bud oil is eugenol. The oil is also made up of about 10% acetyl eugenol and little amount of gallic acid, sesquiterpenes, furfural and vanillin, and methyl-n-amyl ketone. Other ingredients include flavonoids, carbohydrates, lipids, oleanolic acid, rhamnetin, and vitamins.[29] Clove essential oil is effective in reducing inflammation, combating parasitic and microbial infections. It also possesses anti-fungal, anti-viral, cytotoxic and anesthetic properties.[30] In dentistry, clove oil is applied directly to the cavity of the tooth for the relief of toothache.[31]It has been reported that crude methanolic extract of clove has preferential activity against perio-pathogenic bacteria.[32] Kaempferol and myricetin; anti-oxidant polyphenolic compounds have been reported to be significantly bacteriostatic against periodontal pathogens.[33]

Clove oil has been listed as a safe substance by the United States Food and Drug Administration when administered at levels not exceeding 1500 ppm in all food categories. Additionally, 2.5 mg/kg body weight has been established safe for daily human intake by the World Health Organization expert committee on food additives.[27,34]

v. *Nigella Sativa* (Kalonji)

*Nigella Sativa (*NS) (Kalonji) also known as black seed or black cumin is found in Asia, Middle East, parts of Europe and Africa. *Nigella Sativa* is an herbal plant. Its seeds have a strong bitter taste and are used in confectionery and liquors for the sake of aroma and flavor. NS is an aromatic spice, smaller and similar in size to sesame seed. The seeds of NS contains an oil; volatile oil (0.5-1.6%) and fixed oil (35.6-41.6%), proteins (22.7%), amino acids; e.g. albumin, globulin, lysine, leucine, isoleucine, etc., reducing sugars, mucilage, alkaloids, organic acids, ash, moisture and arabic acid. Ascorbic acid and folic acid are also present in it thus contributing to nutritional value.[35] The active ingredients of these seeds include volatile oil comprising of carvone, terpene, alpha- pinene and p-cymene (Kapoor et al, 1990). Pharmacologically active constituents of volatile oil are thymoquinone (TQ), di thymoquinone (DTQ), thymohydroquinone (THQ) and thymol (THY).[36,37] Studies on this plant have shown that NS has anti-oxidant, anti-inflammatory, anti-cancerous, anti-bacterial, anti-fungal and anti-parasitic effects.

NS is also used for dental problems like toothache, gum diseases and oral ulcerations. NS oil when applied to the affected part of tooth for 15 seconds, relieves toothache. Rinsing *Nigella Sativa* oil (1/2 tsp) mix with water prevents premature fall of teeth, teeth loosening, gum bleeding and halitosis. A recent study using biodegradable periodontal chip containing thymoquinone in chitosan base on 12 chronic periodontitis patients has shown reduction in plaque index (PI), bleeding upon probing (SBI), periodontal probing pocket depths (PD) and clinical attachment levels (CAL) as compared to PerioChip containing chlorhexidine which produced adverse effects like brown discoloration, bitter taste and others, thus further suggesting the effectiveness of TQ against periodontal disease.[27]

vi. *Azadirachta Indica* (Neem)

Azadirachta Indica, commonly called "neem" has been used by Asian population for various treatments due to its medicinal properties. The phytochemical composition includes nimbidin, nimbin, nimbolide, azadirachtin, gallic acid, epicatechin, catechin, and margolone. All the constituents possess potent anti-microbial action. The principal active ingredient of *neem* is azadirachtin.[38] Neem is a natural antibacterial agent. Various studies have proved its antibacterial activity.[39]Other properties include anti-cariogenic, anti-helminthic, anti-diabetic, anti-oxidant, astringent, anti-viral, cytotoxic, and anti-inflammatory.[40] Many commercially available toothpastes and mouthwashes contains the active constituent of neem because of its anti-bacterial action. It is very useful in dentistry for

treating gum problems and maintaining natural oral health. It is effective against *S. mutans* and *S. faecali.s*.[41] Its leaves are splendid with anti-oxidants and aids in promoting host immune potential in oral tissues.[42]

Aqueous extract of neem stick when used with gallotannin rich extract from Melaphis chinensis (a Chinese herb) has proved to be bacteriostatic. It also decreases the ability of streptococci to populate tooth surfaces.[43] Several studies have proved the anti-plaque effect of neem. Muco-adhesive oral gel containing *Azadirachta Indica* has been proved to be useful in decreasing the plaque activity and bacterial count in saliva comparatively better than chlorhexidine-based mouthrinses.[44, 45]. It has been shown that neem is effective in the treatment of periodontitis.[46]

vii. *Propolis Resin* (Propolis-Bee Glue)

Propolis Resin, also known as "bee glue", is a natural nontoxic resinous tenacious material formed by honeybees. Thorough blending of the secretions from their hypo-pharyngeal glands along with the dissolved product of resins gathered from leaves, flowers of plants, trees, and certain barks give rise to a sticky substance which is used as a sealant and sterilizer in honeybee nests. It is dark green or brown in color, and its chemical content depends on the geographic zone from which it comes.[47] The term propolis comes from the Greek "pro" meaning in front and "polis" meaning town or city.[48] Active components of propolis are flavonoids, phenolics and aromatics. Its anti-inflammatory effect is due to the existence of caffeic acid and phenethyl ester in it.[49]

Propolis has been used for anti-inflammatory purpose since old times. It has long been consumed in medicine for its favorable properties including antimicrobial, anti-inflammatory, anti-diabetic and local anaesthetic effects.[50] Secondary to its antibacterial and anti-inflammatory activity, it enhances tissue reorganization, therefore, it should be seriously considered as an antioxidant agent in topical formulations.[48]

In dentistry, it is used as an intra-canal irrigant, cariostatic and pulp capping agent and for the treatment of periodontal disease.[51] Owing to substantial levels of anti-oxidants, *Propolis Resin* has also been proposed to have anti-oxidant effects in periodontal disease. It has been proved to act as an anti-calculus agent in toothpastes and mouthwashes. Chewing "honey leather" decreases the gingival inflammation.[13]

CONCLUSION

The most utilized attribute of herbal medicines is its anti-inflammatory effect. Since the dentist frequently battles against intra-oral manifestations of inflammation and infection, there is a rationale for the consideration of the herbal compound's usefulness as an adjuvant to other mechanical and chemical therapies for dental, periodontal and intra-oral mucosal disease.

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CONFLICT OF INTEREST

None to declare

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Author's Contribution

GH: Acquisition of the published data, drafting of manuscript.
SG: Conception and design of study, critical analysis with intellectual output, final approval of the manuscript.