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The Effectiveness of Herbs Used in Treatment of Plaque and Gingivitis

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ABSTRACT: Poor oral hygiene has led to the development of oral diseases, which are a major cause of health problems in manynations. These diseases can cause severe pain, last a lifetime, and even be fatal. Gingivitis, the plague, and other periodontal disorders can also arise from poor dental hygiene. Herbal medicine is becoming a well-known and profitable product. Traditional plaque-controlling agents are beingreplaced by herbal or ayurvedic dental preparations. These goods are promoted as being secure and reliable for guarding against oral health problems. Herbal extracts are applied in dentistry to treat arange of dentalconditions. These extracts have a variety of benefits, including anti-ulcer, anti-caries, anti-bacterial, and wound-healing qualities. They also include unique extra qualities, such as anti-cancer and anti-fungal. A range of oral illnesses with polymicrobial roots, periodontal disease is typified by gingival inflammation brought on by bacterial plaque. The complicated, multifaceted inflammatory disease known as periodontitis is brought on by a dysbiosis between the inflammatory response of the host and the bacterial biofilms.It is impacted by environmental factors like smoking, systemic diseases, and genetic factors. 3.5 billion people worldwide suffer from oral diseases, according to the WHO fact sheet on "Oral health." According to the Global Burden of Disease, the most prevalent illness is dental decay.We anticipate a broad future use of these herbal remedies. The application of herbal remedies for oral diseases presents many more research opportunities. This review offers a thorough analysis of the different herbal remedies and their constituents that are used to treat conditions pertaining to oral hygiene, dental health, and gum and teeth health.Our objective is to talk about the current helpful strategy of using herbal components for periodontal disease and the general opinions of researchers. This review's objectives are to highlight the direction of future research to increase the efficacy of various plants and extracts that have been used to treat periodontal diseases, as well as to concentrate on the potential benefits and drawbacks of these treatments.

Keywords: Herbs, Oral health, Periodontal diseases, Gingivitis, Plaque,Benefits

I. INTRODUCTION

The mouth cavity is a great environment for bacteria growth and expansion, which due to its wet environment can produce dental biofilms [1]. Beyond bacterial slime layers, biofilm is a distinct biological habitat where microorganisms arrange themselves into a well-organized, complex, and useful network that depends on each component to survive [2].It is widely acknowledged that a number of periodontal and other dental diseases are caused by the buildup of microbes and plaque, which develops as a soft deposit from dental biofilm. The meticulously balanced ecosystem could occasionally be upset, which would lead to a dysbiotic shift and, ultimately, the loss of the microbial equilibrium in the biofilm, raising the risk of illness. If the soft supragingival plaque is not cleaned thoroughly at this point, the first indications of gingival inflammation will become apparent. If the early warning signs of gingivitis are disregarded and professional cleaning is not performed, the damage to the periodontium's supporting structures will eventually result from periodontal disease. As a result, the alveolar bone and the supporting periodontal tissue will be destroyed[3].

Brushing your teeth with a dentifrice, an excellent chemical adjunct carrier that has a wide range of chemical ingredients that work well as antibacterial agents, is the most widely used and popular oral hygiene technique. The primary purpose is to prevent dental biofilm from forming. Despite the progress made in biotechnology for

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toothpaste formulation, some consumers in developed and even developing countries continue to clean their teeth with natural sources. A natural product that is frequently used to maintain dental hygiene comes from the Salvadora persica tree[1].

The practice of maintaining good oral hygiene, which includes regular brushing (dental hygiene) and cleaning in between teeth, is what keeps one's mouth healthy and free of diseases and other issues (like bad breath). Maintaining good oral hygiene is essential for preventing dental disease and foul breath. Dental caries and gingivitis are the most prevalent gum diseases, along with periodontitis, as well as tooth decay. Although twice a day brushing is advised by general guidelines, it is ideal to clean the mouth after each meal. As stated by the World Health Organization, "a state of not having periodontal (gum) disease, oral and throat cancer, oral infection and sores, tooth decay, tooth loss, and other diseases and disorders that limit an individual's capacity in biting, chewing, smiling, speaking, and psychosocial wellbeing" is what constitutes oral health. It is estimated that 486 million children worldwide suffer from primary tooth caries, and 2.4 billion people worldwide suffer from caries of the permanent teeth. According to estimates, severe gum disease, or periodontal disease, is the eleventh most common disease worldwide and can lead to tooth loss[4].

From a botanical perspective, herbs are any plants that do not have the woody tissue found in trees or shrubs. more precisely, plants and herbs that are used as medicine or for their flavor or aroma. Medicinal herbs are a helpful and efficient way to treat a variety of medical conditions. Medicinal plants are the source of many medications used in allopathic medicine, a branch of Western medicine. Many proponents of herbal remedies contend that by extracting the chemical rather than utilizing the entire plant, active components like minerals, volatile oils, bioflavonoids, and other compounds that enhance a specific herb's therapeutic qualities are eliminated. Herbs have various uses in medicine such as blood cleansing, warming and stimulating the body, improving blood flow, increasing waste elimination, reducing inflammation, and relieving irritation [5,6].Traditional plaque control treatments are being replaced with herbal or ayurvedic dental medicines, which are becoming more and more popular. These items are promoted as safe and efficient ways to avoid problems with oral health[7].

- **Oral Health**

Our oral health is crucial to our overall well-being, and preventing oral diseases requires good dental hygiene. There are many bacteria in the oral cavity. Many oral disorders are caused by these bacteria when they build up on the oral surface.Dental caries, gingivitis, periodontitis, mouth ulcers, and oral candidiasis are the most prevalent oral illnesses. Dental plaque is the result of bacteria and their byproducts building up on the surface of teeth.Oral disorders are estimated to afflict 3.5 billion people globally, according to the World Health Organization's 2017 Global Burden of Disease Study.In permanent teeth, untreated dental caries, or tooth decay, is most common, according to the Global Burden of Disease report from 2017.The WHO estimates that 80% of people worldwide rely on traditional medicine. Many plants are useful in treating conditions of the mouth. The antibacterial and antifungal properties of herbal medications make them useful. These days, customers have a great desire for dental care solutions that include herbal substances and their extracts. Given that oral care products with synthetic antibacterial agents are more harmful than herbal medications[8].

- **Periodontal Diseases**

The term "periodontium," which refers to the supporting structure around the tooth and consists of the gingival tissue, alveolar bone, cementum, and periodontal ligament, is used to characterize disease disorders involving the periodontium. Up to 90% of people have gingivitis, the most common kind of periodontal disease.This word refers to the inflammation of the gingiva brought on by the build-up of dental plaque, or germs and debris between the gum line and the tooth. Gingivitis is a reactive illness that can be treated with better dental hygiene. When gingivitis is no longer the only periodontal condition present and has developed into a damaging, irreversible, and chronic inflammatory disease state, it is called periodontitis.As a defense against the invasive bacteria, this sets off a host response. The host defenses against the bacteria, however, also cause the periodontium to be destroyed in the process of defending against them. The disease known as periodontitis causes the periodontium to lose its connection, which then causes alveolar bone loss and may ultimately lead to the loss of the tooth under consideration.[9].

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1) Dental Plaque

The accumulation of dental plaque on teeth is problematic due to its pathogenic potential as well as its aesthetic qualities. Dental cavities, gingivitis, periodontal issues, and halitosis may all be caused by the presence of plaque. Globally, a variety of mechanical tools, including as dentifrices, mouth rinses, dental floss, and teeth brushes, are used to reduce or eliminate plaque [10].Herbal elements are beneficial in many ways. For example, echinacea has immune-stimulating qualities, sage and rhatany have anti-hemorrhagic capabilities, myrrh is a natural antiseptic, and peppermint oil has analgesic, antiseptic, and anti-inflammatory properties.[11].The current study was conducted to evaluate the plaque and gingival preventative action of herbal dentifrices because there aren't many studies on their effectiveness currently accessible.The current study was conducted to evaluate the herbal dentifrices' ability to prevent plaque and gingivitis because there aren't many studies on their effectiveness[12].

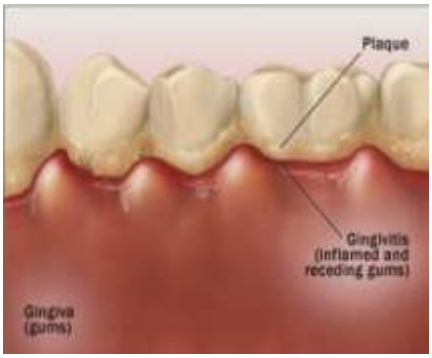

fig 1: plaque

2) Gingivitis

The word "periodontium" refers to the group of tissues that surround a tooth. It is made up of the alveolar bone, cementum, gingiva, and periodontal ligament. Approximately 800 million people worldwide suffer from periodontal diseases, of which 270 million have severe tooth loss and edentulism. Periodontal disease is caused by a wide range of causative factors and systemic diseases, including malignancies, genetic syndromes, and microbial biofilms.The term "gingivitis" describes gingiva inflammation, which typically results from the buildup of plaque biofilm (Fig. 2). Absence of plaque biofilm can also be a symptom of gingivitis and can be caused by a variety of conditions, including neoplasms, bacterial, viral, and fungal infections, autoimmune diseases, and developmental and genetic disorders. These are uncommon causes that are not covered here."An inflammatory lesion resulting from interactions between the dental plaque biofilm and the host's immune-inflammatory response, which remains contained within the gingiva and does not extend to the periodontal attachment (cementum, periodontal ligament, and alveolar bone)" is the definition of gingivitis caused by dental plaque biofilm. Reducing the amount of dental plaque at and apical to the gingival margin can reverse this type of inflammation, which is limited to the gingiva and does not spread past the mucogingival junction. Gingivitis, according to its definition, only affects the gingiva and has no effect on the periodontium's deeper structures. Once the underlying cause is found and addressed, it is typically curable. a close-up of the calculus and dental plaque biofilm on the surface of teeth. These buildups are tough concretions that have developed over several months and are challenging to get rid of with regular brushing. Scaling, or removal, requires the use of specialized dental instruments by qualified professionals[13].

The intricate combination of microorganisms and their substrates is known as dental plaque biofilm. Gingivitis only appears when there is an imbalance between the presence of biofilm and the inflammatory response unique to the host, a condition known as dysbiosis. Biofilm triggers an inflammatory response in the host[14].

fig 2: gingivitis

- **Role of Herbs in Management of Periodontal Disease**

The growing popularity of herbal preparations can be attributed to their affordability, safety, ease of use, and compatibility. Dentifrices are the preparations used to support the appeal and preserve the health of teeth[15].

Herbal products have become more and more popular worldwide for both general and dental health care. Individuals who want to use

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herbal products frequently believe that they are safer than products made with synthetic ingredients[16].

i. NEEM

Modern clinical studies support the ancient Ayurvedic practice of using neem to prevent gum disease and cavities, as well as to repair and rejuvenate gum tissue. The fibrous nature of neem chewing sticks is thought to contribute to some of their observed antiplaque activity, which allows for mechanical plaque removal. However, neem plants also contain chemotherapeutic antiplaque agents.Gallo tannins have the potential to physically remove more bacteria from the oral cavity through aggregate formation, thereby reducing the number of bacteria available for bonding to the tooth surface during the early stages of plaque formation. Furthermore, the presence of Gallo tannin extracts was observed to effectively inhibit glucosyl transferase activity and reduce bacterial adhesion to SHA, which may indicate some potential antiplaque activity [17].

fig 3: neem

ii. CLOVE

Since eugenol and other components of cloves, such as beta-caryophyllene, combine to make cloves a mild anesthetic and an antibacterial agent, eugenol extracts from cloves have been used extensively in dentistry in conjunction with root canal therapy, temporary fillings, and general gum pain. Clove's principal volatile oil constituent, eugenol, has anti-inflammatory properties. Various flavonoids found in clove, such as rhamnetin and kaempferol, also contribute to its anti-inflammatory and antioxidant qualities[17]. Clove is made up of β-caryophyllene, eugenol, eugenol acetate, and essential oil. It possesses antiviral, analgesic, antibacterial, anti-inflammatory, and antioxidant properties. With a mile-long safety record, clove essential oil has been used as a breath refresher. In cases of periodontitis, it has been used as an analgesic, to cure bleeding gums, and to ease toothaches. In locations where access to pharmaceutical topical anesthetics is restricted either to cost or availability, clove gel can offer dentists a viable substitute for benzocaine in their routine practice when used on youngsters. It can be purchased as mouthwash, lozenges, and tincture (1:5, 25% ethanol)[18].

fig 4: clove

iii. TULSI

Common mouth infections can be effectively treated with Tulsi leaves. A few chewed leaves also aid in the maintenance of infections. A few chewed leaves also contribute to the upkeep of the plant's agents. The same purpose is also served by sesquiterpene caryophyllene. This ingredient is a naturally occurring food additive that has FDA approval. Tulsi contains this ingredient[19].Iron, calcium, zinc, and vitamins A and C are all found in Tulsi. Chlorophyll and numerous other phytonutrients are also present. Many oral illnesses have been linked to deficiencies in these nutrients [20]. Tannins (4.6%), essential oil (up to 2%), eugenol (up to 62%), methyl eugenol (up to 86%), α- and β-caryophyllene (up to 42%), methyl chavicol, linalool, and 1,8-cineole are the components of Tulsi. It possesses immune-stimulating, anthelminthics, analgesic, antipyretic, antiulcer, antibacterial, and anti-inflammatory qualities. when treating periodontitis. Used cautiously in children and contraindicated in women who are pregnant or nursing[18].

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fig 5: tulsi

iv. **GARLIC**

One of garlic's most useful ingredients is thought to be allicin. Using the broth dilution method, researchers found that different amounts of allicin suppressed the planktonic growth of gram-positive, cariogenic species, including S. mutans, S. sobrinus, and Actinomyces orris. Allicin was also found to limit the planktonic growth of the gram-negative perio pathogenic species A. and Fusobacterium nucleates[21]. Because of its potent antibacterial properties, it is chopped and then held in the mouth for five minutes to sterilize the oral cavity. In two to three minutes, fresh garlic juice eradicates Streptococcus pyogenes and Oryna bacteria diphteriae[18].


fig 6: garlic

v. **TURMERIC**

Turmeric that has been ground and roasted is used to massage sore teeth to relieve pain and discomfort. According to a study, using mouthwash containing turmeric and chlorhexidine gluconate in addition to mechanical plaque control techniques can effectively prevent plaque and gingivitis. Turmeric's anti-inflammatory properties may be the reason of the effect that has been seen[22]. Turmeric's chemical composition includes volatile oil (6%), which is made up of several monoterpenes and sesquiterpenes, such as zingiberene, curcumin, and α- and β-turmerone. It is utilized in dental caries, oral lichen planus, gingivitis, halitosis, pit and fissure sealants, and dental plaque detection systems. It is also antimutagenic, anticarcinogenic, antioxidant, and antibacterial. Applying ground turmeric, which has been roasted, to sore teeth reduces swelling and pain[23].


fig 7: turmeric

vi. MISWAK

While toothbrushes with nylon bristles are the most popular oral hygiene aid in most developed nations, teeth-cleaning sticks, also known as Miswak or Siwak, are popular oral hygiene aids in India, Pakistan, most Arabian countries, and some African countries. In both industrialized and emerging nations, the use of miswak and other herbal items is rising at an exponential rate due to their accessibility for free, their distinct chemical makeup, and religious beliefs. Additionally, miswak has been endorsed and promoted by the World Health Organization (WHO) as a useful oral hygiene technique[24]. Several writers have recently come to the conclusion that these chewing sticks, or their extracts, can treat gingivitis[25]. Tri-methylamine, salvadrin, chloride, fluoride, silica, sulfur, mustard, vitamin C, and a trace amount of saponin were found in S. persica, according to a primary

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analysis. These ingredients not only prevent gingival irritation but also have antibacterial and antifever properties[26].

fig 8: miswak

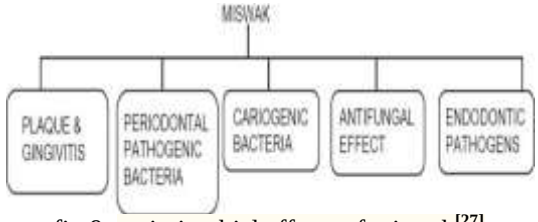

fig 9: antimicrobial effects of miswak[27]

vii. ALOE VERA

Aloe vera, or Aloe barbadensis, is a plant that belongs to the Lily family. Because it is a xerophyte type plant, it can store a significant amount of water and adapt to decreased or variable water availability. Some of the plant's naturally occurring anthraquinones with antimicrobial qualities are resistannol, anthranol, cinnamomic acid esters, chrysophanic acid, aloin, aloe emodin, barbaloin, aloetic acid, isobarbaloin, and anthracine[28]. In a clinical research, aloe vera mouthwash was shown to be beneficial in reducing the development of gingivitis and plaque[29].Aloe vera polysaccharides have also been connected to direct bacterial activity through the stimulation of phagocyticleukocytes, which results in the death of bacteria[30].Aloe vera has a number of benefits, including anti-inflammatory, analgesic, wound healing, stomatitis, gingival health, immunostimulant, and efficaciousness against varicella-zoster virus and herpes simplex types 1 and 2[31].

fig 10: aloe vera

viii. **GREEN TEA**

Leaves of Camellia sinensis, used to make green tea, are treated with little to no oxidation. It possesses the highest concentrations of polyphenols, also known as catechins and acting as natural antioxidants. Catechin, gallon catechin, epicatechin, epigallocatechin, epicatechin gallate (ECg), and epigallocatechin gallate (EGCg) are the six main catechin components found in green tea. Of all the other compounds, EGCg has been studied extensively and is a particularly potent antioxidant when it comes to action. In addition to a range of phytochemical compounds, green tea contains tocopherols, selenium, carotenoids, ascorbic acid, chromium, and zinc.Green tea's catechins have shown promise as an antibacterial agent against periodontal diseases. Anaerobic bacteria including Porphyromonas gingivitis and Prevotella spp. are the main causes of periodontitis. The in vitro study showed that P. gingivitis and Prevotella nigrescens cannot develop when these herbal medicinal ingredients are present. This further prevents P. gingivitis from sticking to the epithelial cells of the human buccal cavity[32].

fig11: green tea

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Benefits of Herbal Drugs

Herbal medications are more widely accepted by the general population and have a lengthy history of use and good patient tolerance. Periodontal disease and dental caries are the most prevalent oral illnesses.It is a frequent but easy oral condition, but the cost of dental care in rural areas is very high, and for those living there, alternative treatment is preferred. The preparation of medicinal plants varies according to the type of plant, parts used (stems, leaves, and roots), administration route (local, topical, and rinsing), and consumption time.Plant extracts are used as mouthwashes and teas in certain places, and people with dental problems chew the bark of several trees to relieve inflammation or prepare fillings from plants[33].

Advantages of Herbal therapy

There are numerous potential benefits of using herbal therapy. Because of the synergy of their active compounds to have preventative effects, stimulate the regulation action of the defense systems of the body, and prepare for potential activity against external agents, some plants have been found to be more effective than pharmaceuticals at mending the entire body.Because of improved tolerance and adaptability, side effects are frequently mild and therapeutic effects endure longer. Unlike pharmaceuticals that are prescribed for a specific ailment, herbal therapy can function as a co-treatment with conventional treatments or on multiple targets at once[34].

Table1:List of some important herbal remedies with their active component and pharmacological actions [32].

SR NO	COMMON NAME	BOTANICAL NAME	ACTIVECOMPONENT	PHARMACOLOGICAL EFFECT	DOSAGE FORM
1	Miswak (Roots)	Salvadora persica twigs, stem	Fluoride, alkaloids, Sulphur compounds, Glucosinolate, volatileoils	Anti-microbial, antiplaque	Toothpaste & Used as Toothbrush
2	Guava (Leaves)	Psidium guajava	Guaijaverin, Quercetin Ascorbic acid, flavonoids	Anti-oxidant, Anti-microbial, Antiplaque, anti-Inflammatory.	Powder, Gel, Toothpaste
3	Turmeric (Rhizome)	Curcuma longa	Curcumin, curcuminoid Desmethoxycurcumin	Anti-inflammatory, Antimicrobial, Astringent, anti-septic, Anti-oxidant and Analgesic.	Tablet & Toothpaste
4	Aloe Vera (Leaves)	Aloe Barbadensis	Vitamins, minerals, enzymes, polysaccharides, phenols, organic acids	Anti-microbial, Anti-inflammatory	Oral gels toothpaste

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5	Neem (Leaves)	Azadirachtaindica	Azadirachtin, Nimbi, gallic acid, catechin, Margolin	Antibacterial, Antioxidant, Anti-inflammatory, Host immune-modulator, Anti-plaque	Toothpaste, Gel
6	Bee glue(Leaves, flowers& barks)	Propolis Resin	Flavonoids, phenols, aromatics, caffeic acid, phenethyl ester	Anti-inflammatory, Anti-bacterial, local anesthetic, Antioxidant, Anti-calculus	Oral cleaner, Powder, Tablet
7	Clove (Dried flower buds of clove)	Eugenia caryophyllus	Eugenol, gallic acid, sesquiterpenes, furfural, flavonoids, kaempferol; myricetin	Anti-oxidant, Antiseptic, Anti-bacterial, Analgesic, Bacteriostatic	Oil & Gel
8	Babul or Indian gum Arabic (Bark, root)	Vachellia nilotica	Tannins, phenols, essential oils, flavonoids	Anti-bacterial, Antiplaque	Toothpaste
9	Tulsi (Leaves)	Osmium sanctum	Vitamin A, Iron, Zinc, calcium and Vitamin C.	Anti-inflammatory expectorant, analgesic, anticancer, anti-asthmatic, antiemetic, diaphoretic, antidiabetic	Powder
10	Lemon grass (Leaves)	Cymbopogon Citrus	Citronellol, Geraniol	Antioxidant, Anti-bacterial, antifungal, Anti-inflammatory and antiseptic.	–

II. CONCLUSION

A common indigenous medical practice that needs to be incorporated into daily life is the use of plants and herbs for dental care. Modern oral health care procedures should incorporate the active principles of plants, and dentists should be urged to employ natural remedies in a range of oral health care procedures.In addition to calming and soothing irritation, herbs are used to reduce inflammation. Herbs can be applied topically as plasters, liniments, and poultices, or as tablets, syrups, and infusions for internal use. For people in lower socioeconomic groups in society, this will make dentistry much safer, more affordable, and more accessible. Ayurvedic herb efficacy trials ought to be conducted in developing nations such as India in the future to determine the benefits of the herbs alone or in conjunction with traditional therapies.Herbal products can be used as a substitute for conventional (non-herbal) products and do not cause any negative side effects when used. From now on, people's preference will determine which natural (herbal) products they select. We may infer from the study's findings that

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using products with a herbal base significantly reduced the amount of plaque and gingival inflammation.

REFERENCES

[1]. Adam FA, Mohd N, Rani H, Yusof MY, Baharin B. Salvadora persica L.; An effective anti-plaque and anti-gingivitis toothpaste: A Systematic Review & Meta-analysis of Randomized Control Clinical Trials. Journal of Herbal Medicine. 2023 May 26:100677.

[2]. Zambon JJ. American Academy of Periodontology Consensus report periodontal disease. Microbial factors. Annals of Periodontology. 1996;67:879-925.

[3]. Caton JG, Armitage G, Berglundh T, Chapple IL, Jepsen S, Kornman KS, Mealey BL, Papapanou PN, Sanz M, Tonetti MS. A new classification scheme for periodontal and peri-implant diseases and conditions–Introduction and key changes from the 1999 classification. Journal of periodontology. 2018 Jun;89:S1-8.

[4]. Dhage VS, Chougule P. Importance of oral hygiene in oro-dental diseases: A review study. International Journal of Research and Review. 2019;6(12):69-74.

[5]. Duke JA. Handbook of medicinal herbs. CRC press; 2002 Jun 27.

[6]. Rotblatt M, Ziment I. Evidence-based herbal medicine. (No Title). 2002.

[7]. Howshigan J, Perera K, Samita S, Rajapakse PS. The effects of an Ayurvedic medicinal toothpaste on clinical, microbiological and oral hygiene parameters in patients with chronic gingivitis: a double-blind, randomised, placebo-controlled, parallel allocation clinical trial.

[8]. Lawarence B, Greeshma GM, Manoj GS, Murugan K, Krishnan R. Bryophytes: Hoard as emerging lower plant group in Ethno-medicinal usage by local vendors from Kerala some observations. Research Journal of Pharmacy and Technology. 2023 Apr 1;16(4):1895-900.

[9]. Gasner NS, Schure RS. Periodontal disease. InStatPearls [Internet] 2023 Apr 10. StatPearls Publishing.

[10]. Barnes VM, Richter R, DeVizio W. Comparison of the short-term antiplaque/antibacterial efficacy of two commercial dentifrices. J Clin Dent. 2010 Jan 1;21(4):101-4.

[11]. Radafshar G, Mahboob F, Kazemnejad E. A study to assess the plaque inhibitory action of herbal-based toothpaste: a double blind controlled clinical trial. J Med Plants Res. 2010 Jun 18;4(12):1182-6.

[12]. Tatikonda A, Debnath S, Chauhan VS, Chaurasia VR, Taranath M, Sharma AM. Effects of herbal and non-herbal toothpastes on plaque and gingivitis: A clinical comparative study. Journal of International Society of Preventive & Community Dentistry. 2014 Dec;4(Suppl 2):S126.

[13]. Laudenbach JM, Kumar SS. Common dental and periodontal diseases. Dermatologic Clinics. 2020 Oct 1;38(4):413-20.

[14]. Hajishengallis G, Lamont RJ. Beyond the red complex and into more complexity: the polymicrobial synergy and dysbiosis (PSD) model of periodontal disease etiology. Molecular oral microbiology. 2012 Dec;27(6):409-19.

[15]. Ahad HA, Haranath C, Kondaveeti S, Konjeti S, Gangireddy S, Ibrahim O. Herbs in dentifrices for dental care and hygiene: a comprehensive review. Research Journal of Pharmacy and Technology. 2020 Oct 1;13(10):5052-4.

[16]. Divya S, Suresh J, Meenakshi S. Comprehensive Review on Herbal Toothpaste. Annals of the Romanian Society for Cell Biology. 2021 Apr 24:9509-18.

[17]. Wolinsky LE, Mania S, Nachnani S, Ling S. The inhibiting effect of aqueous Azadirachta indica (Neem) extract upon bacterial properties influencing in vitro plaque formation. Journal of dental research. 1996 Feb;75(2):816-22.

[18]. Buggapati L. Herbs in dentistry. International Journal of Pharmaceutical Science Invention. 2016 Oct;5(6):07-12.

[19]. Agarwal P, Nagesh L. Evaluation of the antimicrobial activity of various concentrations of Tulsi (Ocimum sanctum) extract against Streptococcus mutans: An: in vitro: study. Indian Journal of Dental Research. 2010 Jul 1;21(3):357-9.

[20]. Tulsi Medicinal Ingredients. Available at http:/www.tulsiherbalte
[21]. Bachrach G, Jamil A, Naor R, Tal G, Ludmer Z, Steinberg D. Garlic allicin as a potential agent for controlling oral pathogens. Journal of Medicinal Food. 2011 Nov 1;14(11):1338-43.
[22]. Behal R, Mali AM, Gilda SS, Paradkar AR. Evaluation of local drug-delivery system containing 2% whole turmeric gel used as an adjunct to scaling and root planing in chronic periodontitis: A clinical and microbiological study. Journal of Indian society of Periodontology. 2011 Jan;15(1):35.
[23]. Chaturvedi TP. Uses of turmeric in dentistry: An update. Indian Journal of Dental Research. 2009 Jan 1;20(1):107-9.
[24]. Petersen PE, Bourgeois D, Bratthall D, Ogawa H. Oral health information systems-towards measuring progress in oral health promotion and disease prevention. Bulletin of the World Health Organization. 2005;83:686-93.
[25]. Wu CD, Darout IA, Skaug N. Chewing sticks: timeless natural toothbrushes for oral cleansing. Journal of periodontal research. 2001 Oct;36(5):275-84.
[26]. Wolinsky LE, Sote EO. Isolation of natural plaque-inhibiting substances from 'Nigerian chewing sticks'. Caries research. 1984 Nov 18;18(3):216-25.
[27]. Sukkarwalla A, Ali SM, Lundberg P, Tanwir F. Efficacy of miswak on oral pathogens. Dental research journal. 2013 May;10(3):314.
[28]. Hassan G, Ghafoor S. Herbal Medicines: An Adjunct to Current Treatment Modalities for Periodontal Diseases. Biomedica. 2020 Mar 1;36(1).
[29]. Araghizadeh A, Kohanteb J, Fani MM. Inhibitory activity of green tea (Camellia sinensis) extract on some clinically isolated cariogenic and periodontopathic bacteria. Medical Principles and Practice. 2013 Jun 1;22(4):368-72.
[30]. Chandulal D, Jayshri W, Kantilal I. Herbal remedies in periodontics. Indian J Dent Adv. 2015 Oct 1;7(4):255-8.
[31]. Lee SS, Zhang WU, Li Y. The antimicrobial potential of 14 natural herbal dentifrices: results of an in vitro diffusion method study. The Journal of the American Dental Association. 2004 Aug 1;135(8):1133-41.
[32]. Kakad AV, Laddha UD, Kshirsagar SJ, Khairnar SJ. Traditional Herbal Remedies for Periodontitis. Biosciences Biotechnology Research Asia. 2022 Dec 20;19(4):1079-91.
[33]. Ramesh A, Varghese SS, Doraiswamy JN, Malaiappan S. Herbs as an antioxidant arsenal for periodontal diseases. Journal of intercultural ethnopharmacology. 2016 Jan;5(1):92.
[34]. Raju Anarthe D, Mani A, Kale P, Maniyar S, Anuraga S. Herbal approaches in periodontics. Galore Int J Health Sci. 2017;2:18-25.