

PHYTODENTISTRY: THE ROLE OF INDIGENOUS HERB IN ORAL HEALTH IN INDIA

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ABSTRACT

More than 800 species of microorganisms harbour in the oral cavity. The use of herbs is an ancient tradition and can be an alternative to conventional treatments for oral diseases. Therefore, dental practitioners should be aware of the growing trend of herbal products and understand their mechanisms of action to treat and alleviate dental problems. Bioactive constituents in herbal medicine can limit the production of proinflammatory mediators, induce apoptosis, possess immune-enhancing effects, and contribute to safer, cheaper, and greener dentistry.

KEYWORDS: Herbal Plants, Phytodentistry, Antimicrobial, Dental Caries, Gingivitis.

INTRODUCTION

Oral disease is a significant global health problem that affects an individual's quality of life. The global burden of oral disease has remained largely unchanged and at a peak over the last 30 years. According to GOHAP, 3.5 billion people were affected by oral diseases worldwide in 2019. An estimated 3.69 billion people worldwide were affected by principal oral conditions (untreated caries, severe periodontitis, edentulism, and other oral disorders) in 2021.^[1] Chemical and synthetic agents used in oral treatment may cause altered taste sensation, allergic reactions, toxicity, and even financial burden. Herbal extracts and their products can be an intriguing alternative to synthetic drugs. The term 'phytodentistry' refers to the practice of treating and preventing oral diseases with medicinal herbs and their extracts.^[2] The demand and acceptance of herbal medications are increasing. India is

home to a vast collection of indigenous plants that have been used since time immemorial due to their antibacterial and immune modulatory properties against various microorganisms. Natural phytochemicals show promise as potent antibiotic substitutes. These have been recommended for the treatment of purulent gingivitis, mucositis, mycosal infections, oral lesions, and difficult healing of postoperative wounds.

History

The foundational knowledge of Ayurveda, one of the oldest traditional medicines, is rooted in Vedic civilization, particularly in the Atharvaveda. Ayurvedic philosophies are also found in the key ancient texts of Charaka Samhita and Sushruta Samhita. Phytotherapy for oral diseases is an age-old custom that has evolved over the years, dating back to 200 B.C.^[3] More than 800 plant species are used to treat various oral diseases. Herbs used in Ayurveda are from nature and primarily utilize various parts of medicinal plants like seeds, leaves, bark, flowers, roots, and fruits. For example, the use of miswak, a chewing stick, is still common and is also used in herbal toothpaste.

The recommended methods in Ayurveda for oral care include^[4]

* Dant Dhavani, Jivha Lekhana, Gandusha, Tissue regeneration therapy (trophorestoration), Alkaloids, Phenols and phenolic glycosides, Polyphenols and Terpenoids and essential oils.

Application of Phytomedicine in Dentistry

These phytotherapeutic substances can be used for a variety of purposes in dentistry. They can be used as pulp capping agents, intracanal medicaments, pit and fissure remineralizing agents, storage media for avulsed teeth, and as hemostatic agents in cases of periodontitis. Some dental products used in dentistry originate from plants, such as gutta percha, impression materials, zinc oxide eugenol, citric acid, camphor monochloro-phenol, and thymol. These can be synoptically represented in a tabular format. **Table 1.**

Table 1: - Herbal agents and its applications.

Application	Herbal Agents
Antiplaque/Anticaries	Neem, Miswak, Babool, Guava, Propolis, Tulsi, Triphala
Root Canal Irrigants	Babool, Turmeric, Bakuchi, Aloe vera, Garlic, Cinnamon, Ashwagandha, Noni
Treatment of oral lesions.	Clove, Aloe vera, Turmeric, Liquorice, Myrrh, Pomegranate
Wound healing	Myrrh, Alo vera, Guava, Amla
Storage media for avulsed tooth	Coconut water
Precancerous/Cancer Therapy	Turmeric, Tomato (Lycopene), Ginger, Garlic
Tooth Whitening/Natural Dentifrice	Miswak, Tomato, Papain
Oil Pulling	Sesame Oil, Coconut Oil

Herbs in Practice: - The following are summarized in Table2.

1. Neem (*Azadirachta indica*): Known as the "miracle tree," Neem originates from Indian subcontinent and is referred to as the "Village pharmacy" due to its widespread use of almost every part of the tree in traditional medicines for centuries.

* Active component: Nimbidin is the main active component responsible for neem's antimicrobial and antiplaque activity.

* Mechanism of action: The barks and twigs inhibit the adhesion of plaque-forming microorganisms. It inhibits bacterial growth, prevents the adhesion of hydroxyapatite on tooth surfaces, and inhibits the production of insoluble glucan, thereby preventing plaque formation.^[5]

* Dental application: Toothpaste containing neem has been shown to be as effective as toothpaste containing fluoride. Extracts of neem leaf have been used as intracanal medicaments and root canal irrigants. Neem sticks have been used as toothbrushes for ages.

2. Miswak (*Salvadora persica*): It is an ancient desert tree used predominantly as tooth brush for maintenance of oral hygiene for thousands of years.^[6]

a. Active components: Miswak contains abundant vitamin C and sulfur, trimethylamine, salvadorine, flavonoids, saponins, and sterols.

b. Mechanism of action: Compounds found in miswak interact with the bacterial cell wall and inhibit enzymes crucial for bacterial metabolism and survival. Chewing miswak increases saliva production, and saliva neutralizes the acidic environment created by bacteria, reducing the risk of tooth decay.^[7]

c. Dental application: Miswak sticks have been used for brushing teeth. Mouth rinse containing 40% miswak has antiplaque activity and can be as effective as fluoride mouthwash in controlling *S. mutans*. Studies have shown that the chemical composition of miswak strengthens tooth enamel, reduces gingivitis, promotes wound healing, and has some teeth whitening effects.

3. Babool (*Acacia nilotica*): Babool, a native of the African and Indian subcontinent is found ubiquitously. It is chewed as a natural way to clean teeth and strengthen gums.

a. Active components: It is a rich source of various organic and inorganic components like gallic acid, protocatechuic acid, pyrocatechol, lupenone, lupeol, saponins, glycosides, and phlobetannins.^[8]

b. Dental application: It has proven effective against *S. mutans*, *S. aureus*, *S. viridans*, and *C. albicans*. Studies have shown its efficacy when used to disinfect gutta percha and promising results when used as a root canal irrigant. It is largely used as an ingredient in dentifrices.^[9]

4. Bakuchi (*Psoralea corylifolia*): It is known in traditional Ayurveda to be an effective remedy for various skin conditions. Its potency in oral health is increasingly explored.

- a. Active component: Bakuchiol is the main constituent.
- b. Mechanism of action: Bakuchiol disrupts the cell membrane and exhibits bactericidal activity. Its key constituent, flavonoid, limits the release of reactive oxygen and cytokines.^[10]
- c. Dental application: It is used as a root canal irrigant for its efficacy against *E. faecalis*. It is also used in treating autoimmune lesions in the oral cavity.^[1]

5. Turmeric (*Curcuma longa*): This vibrant yellow spice, a native from South East Asia has been a corner stone of Ayurvedic medicines for over 4000 years. It has potent anti-inflammatory properties.^[12]

- a. Active components: The active components in curcumin, called curcuminoids, reduce the extent of inflammation.
- b. Mechanism of action: It prevents oncotransformation in oral submucous fibrosis by reducing the formation of micronuclei. It can block the fibrosis of tissue through its antifibrotic property. *Curcuma longa* inhibits leukocyte influx and the biosynthesis of inflammatory prostaglandins from arachidonic acid.^[13]
- c. Dental application: It is used as an intracanal medicament as it inhibits *S. mutans* and *E. faecalis*. Turmeric chips have proven as effective as chlorhexidine when used in gingivitis and periodontitis. It is also used to manage dry sockets and can treat precancerous lesions as curcumin present in it can kill cancer cells.

6. Ginger (*Zingiber officinale* Roscoe): Cultivated for thousands of years Primarily in Asia, this spice rhizomes is a staple spice predominantly used in folk medicines.

- a. Active component: Gingerol is the main component in ginger, which can help in alleviating pain.
- b. Mechanism of action: Ginger's antioxidant property protects cell damage from free radicals and suppresses angiogenic factors to prevent tumor growth and proliferation.^[14]
- c. Dental application: It strengthens tooth enamel. Chewing on fresh ginger near the affected area can reduce inflammation and discomfort. It is also used to treat xerostomia, aphthous ulcer, dental caries, and candidal infection. When consumed systemically or included in the diet, it can improve salivation rate and promote overall health benefits.^[15]

7. Garlic (*Allium sativum*): Garlic is a bulbous flowering plant in the genus *Allium* originating from Central Asia. It is revered in traditional Indian medicines.

- a. Active ingredient: Allicin is the main component in garlic, which reduces harmful microbes through its antibacterial and antifungal properties.^[16]
- b. Mechanism of action: It destroys the cell membrane of *A. actinomycetemcomitans* and *F. nucleatum*. It is also effective in periodontal disease by reducing microorganisms like *P. gingivalis*,

S. sobrinus, *P. intermedia*, etc. Fresh garlic can prevent the onset of oral cancer by removing free radicals and enhancing enzymes like glutathione S-transferase and catalase, reducing cytochrome p-450, and restoring DNA structure.^[17]

c. Dental application: It is used as a root canal irrigant.

8. Cinnamon (*Cinnamomum zeylanicum*): Cinnamon belongs to the genus *Cinnamomum* and is obtained from the bark of the tree. It is a prominent condiment in Indian Cuisine and is one of the oldest known spice. Cinnamon was considered as valuable as “Gold”.

a. Active component: The main components identified in cinnamon are cinnamaldehyde, eugenol, phenol, and linalool.

b. Mechanism of action: It exhibits antibacterial activity by destructing the cell membrane of bacteria, leading to leakage of cellular contents and ultimately cell death. It disrupts cellular processes like ATP production, inhibits bacterial enzymes, and interferes with cell division. It interferes with quorum sensing, a process bacteria use to coordinate their behavior, and thereby inhibits biofilm formation.

c. Dental applications: It helps in reducing gum inflammation and minor toothaches. Essential oil of cinnamon is used to treat candidal infection and recurrent aphthous stomatitis. Nanoparticles of cinnamon are used in GIC cement to enhance their antibacterial properties.^[18, 19]

9. Clove (*Syzygium Aromaticum*): Clove, a native to Maluku spice Island is a prized aromatic flower bud that are highly regarded for their medicinal and culinary use in India and China.^[20]

a. Active components: It consists of essential oil, 60-90% eugenol, 10% eugenol acetate and beta caryophyllene, and small quantities of gallic acid, sesquiterpenes, vanillin, and flavonoids.^[21]

b. Mechanism of action: It inhibits germ tube formation of *C. albicans* and is also effective against *S. mutans*, which is responsible for dental caries. It causes a reduction in microorganisms by destructing the cell membrane. Its potent analgesic effect is due to the activation of calcium and chloride channels in ganglion cells. It suppresses the inflammatory response by prostaglandin synthesis, thereby exhibiting a depressant effect on sensory nerves (obtundent effect).^[21]

c. Dental application: It is used as a restorative material, in periodontitis, to cure halitosis, as an anesthetic agent, and also to treat bleeding gums.

10. Aloe vera (*Aloe barbadensis*): It is a plant belonging to the Liliaceae family. More than 300 species of aloe vera are found, but only *Aloe barbadensis* has medicinal properties.^[22, 23]

a. Active components: The active ingredients are chromone and anthraquinone and its glycoside derivatives.

b. Mechanism of action: Its immunomodulating and analgesic mechanism lies in interfering with the cyclooxygenase pathway, reduction in prostaglandin, and breakdown of bradykinin. It also

blocks mast cells from releasing histamines and leukotrienes. It limits leukocyte adherence and TNF alpha, thereby blocking the inflammatory process.^[24]

c. Dental application: It is used in a variety of spheres in dentistry, such as to treat periodontitis, chemical burns, aphthous ulcers, lichen planus, gum abscess, healing dry socket, migratory glossitis, burning mouth syndrome, denture sore mouth, candidiasis, desquamative gingivitis, OSMF, acute monocytic leukemia, vesiculobullous disease, and xerostomia.

11. Tulsi (*Ocimum sanctum*): Tulsi, the elixir of life, is a sacred plant to Hinduism meaning the “Incomparable one”. It is Omnipresent in almost every Indian home and is a prime ingredient in Ayurvedic medicines.

a. Active ingredients: Tulsi contains tannins, essential oil, eugenol (up to 62%), alpha-beta caryophyllene, and methyl chavicol.

b. Mechanism of action: Eugenol, being the main component, permeates and ruptures bacterial cell membranes, causing leakage of cellular contents like proteins and lipids. It interferes with bacterial protein synthesis and inhibits certain enzymes crucial for bacterial metabolism and survival.^[25]

c. Dental application: Tulsi is used in dentifrices and as an intracanal medicament in primary teeth and can be safely used as an obturating material in primary teeth.^[26] Tulsi is used to treat toothaches and address periodontal issues by managing gingivitis and periodontitis.

12. Noni (*Morinda citrifolia*): Noni has been promoted as an imported medicinal tropical fruit (herb) for treatment of various physiological disorders worldwide. Known as Indian Mulberry Noni has been used traditional medicines with remarkable results.

a. Active component: It includes anthraquinones, scopoletin, terpene, flavonoids, phenolic acids, iridoids, alkaloids, and polysaccharides.

b. Mechanism of action: Noni inhibits bacteria by disrupting cell membranes, interfering with cellular processes, and affecting bacterial metabolism, particularly the TCA cycle. It also affects the quorum sensing process of bacteria, which they use to coordinate their behavior.^[27]

c. Dental application: Extracts of ripe noni fruit can be an effective mouth rinse and oral swishing agent to treat periodontitis. It is used as a substitute in intraosseous defects to promote bone regeneration. It can also be employed for cavity disinfection and as a root canal irrigant.^[28]

13. Liquorice (*Glycyrrhiza glabra*): This celebrated herb or “Mulethi” as it is known in India has widespread culinary and medicinal use in traditional India.

a. Active component: Liquorice, derived from a Greek word, contains licoricidin and licorisoflavan A, glabridin, flavonoids, phenols, pterocarpan, coumarins, and saponins, which make it pharmacologically useful.

b. Mechanism of action: Liquorice contains glabrol, licochalcone A, and licochalcone C, which rapidly kill MRSA via the disruption of the cell membrane. It interferes with bacterial gene expression, growth, and toxin production. It reduces the acid production of *S. mutans*, prevents plaque formation, and alleviates inflammation.^[29]

c. Dental application: It has been explored for its potential to treat oral candidiasis and even oral ulcers.^[30]

14. Ashwagandha (*Withania somnifera*): An ancient Indian herb, its roots are known for their adaptogenic properties.

a. Active components: The biologically active components in ashwagandha include alkaloids (isopelletierine, anaferine, cuscohygrine, anahygrine), steroidal lactones (withanolides, withaferins), and saponins.

b. Mechanism of action: It boosts the immune system and inhibits bacterial growth. It destroys bacteria by enhancing the activity of immune cells like macrophages to engulf bacteria and also stimulates the production of antibodies that neutralize pathogens. It disrupts the cell membrane of bacteria and increases nitrogen production, which helps macrophages function effectively.^[31]

c. Dental application: Ashwagandha showed better penetrability into the dentinal tubules compared to synthetic irrigants. It decreases biofilm production and can be used as an alternative vehicle for intracanal medicament.^[32]

15. Myrrh (*Commiphora myrrh*): Myrrh or Guggul is an aromatic resin derived from Indian Bdellium tree. It is highly valued for its use in incense sticks and medicines.

a. Active component: Its active ingredients include volatile oil containing various terpenoids, and terpenes including furanodienes like curzerene and lindestrene.

b. Mechanism of action: Its healing properties are due to the activation of white blood cells, dermal fibroblast proliferation, and an increase in collagen mRNA production.

c. Dental application: It is effective in treating gingivitis, reducing plaque, and promoting wound healing in extraction sites. Myrrh tincture is used as a mouthwash to alleviate oral ulcers and sore mouths.^[33]

16. Propolis: Propolis is a remarkable resinous product collected by bees from tree buds which has been harnessed for its benefits in human health since centuries.

a. Active component: It is rich in flavonoids and phenolics, which are responsible for its strong antioxidant property.^[34]

b. Mechanism of action: It affects the survival of *S. mutans* by inhibiting glucosyltransferase activity and F-ATPase activity.

c. Dental applications: It can be incorporated into dental varnish, chewing gums, and mouth rinses

to decrease biofilm production. It can be used as a root canal irrigant for its bactericidal effect against a large number of root canal pathogens. It can be used in periodontal pockets, gingival abscesses, lichen planus, candidal infections, xerostomia, traumatic ulcers, dry socket, pulp capping, and in pericoronitis.^[34, 35]

17. Amla (*Embllica officinalis*): Amla or Indian gooseberry is considered as superfood in ayurvedic medicines, It has the highest concentration of Vit C and traditionally used as detoxifying and purifying agent.

18. It can be beneficial for teeth and gums as it reduces plaque, strengthens gums, and combats bad breath.^[36]

a. Active components: The main constituents are tannins like emblicanin A and B, alkaloids, gallic acid, ellagic acid, quercetin, and vitamin C.

b. Mechanism of action: The compounds in it help neutralize free radicals, reduce oxidative stress, and modulate cellular pathways involved in inflammation, cell growth, and metabolism.

c. Dental application: As amla juice is enriched in vitamin C, it is effective in oral ulcers and reduces the healing period. 10% *Embllica officinalis* in mouthwash reduces periodontal inflammation.

19. Triphala: It is a synergistic combination of three fruits: *Embllica officinalis*, *Terminalia chebula*, and *Terminalia bellirica*. This blend forms the backbone of ayurvedic system of medicines. Highly regarded for its cleaning and immune boosting properties.

a. Active constituent: Amla is rich in ascorbic acid, thiamine, riboflavin, and niacin, whereas haritaki has chebulagic and chebulinic acid and corilagin. Bellirica contains gallic acid, ellagic acid, and chebulagic acid.

b. Mechanism of action: The Triphala mixture prevents the adhesion of *S. mutans* to the tooth surface and declines colony formation. It also interferes with sucrose-induced cohesion and glucan-induced conglomeration, which promotes *S. mutans* growth.

c. Dental application: It is used in bleeding gums, dental caries, and periodontitis.

Triphala-containing mouthwash reduces the caries index and is also used as a potent root canal irrigant due to its antimicrobial property. Using Triphala-containing mouthwash twice daily has shown a reduction in streptococcus counts.^[37, 38]

20. Coconut (*Cocos nucifera*): The coconut palm is known as Kalpa Vriksha in Sanskrit meaning tree that provides for everything necessary for living highlighting its immense versatility.

a. Active component: Coconut water is a powerhouse of nutrients, and its content is similar to human plasma, having an osmolarity of 372 mOsm/L. It contains vitamins, cytokinins like trans-zeatin, and antioxidants such as vitamin C, catechin, and epicatechin.

b. Mechanism of action: It exerts its antibacterial activity by inhibiting bacterial cell wall synthesis, altering cell membrane permeability, and interfering with bacterial metabolism.

c. Dental application: The cells can remain vital for 15-20 minutes without much cell death. It is gaining popularity as a new storage media for avulsed teeth as it maintains viable periodontal ligament and can be a better alternative to Hank's Balanced Salt Solution or milk. It enhances immune function, possesses anti-aging properties, and relieves spasms due to its unique nutritional profile.^[39]

21. Papain (Papaya proteinase L): It has been traditionally used for its digestive and anti-inflammatory property.

a. Active component: Papain, a proteolytic enzyme, is derived from papaya.

b. Mechanism of action: The absence of plasmatic antiprotease called alpha-1-antitrypsin in infected tissue allows papain to break down only degraded collagen molecules, thus contributing to the degradation of the fibrin mantle formed in the carious process. This technique can be an effective alternative to treat dental caries.^[40]

c. Dental applications: It is used in dental care for its anti-inflammatory, bacteriostatic, and bactericidal characteristics and efficacy against gram-positive and gram-negative organisms. It is used in tooth whitening gels and dentifrices.

22. Guava (*Psidium guajava*): The leaves of Guava plant have been chewed for generations.^[41]

a. Active component: Quercetin and guaijaverin, flavonoids, and tannins regulate antiplaque activity.

b. Mechanism of action: The rich vitamin C content in guava plays a role in collagen synthesis to promote healthy gums. Some contents in it damage bacterial cell membranes, inhibit bacterial enzymes essential for various metabolic processes, and thereby hinder bacterial growth. Flavonoids and polyphenols neutralize harmful free radicals within bacterial cells, prevent oxidative damage, and promote cell death.^[41]

c. Dental applications: Guava leaves are chewed, and if used in mouth rinse, can decrease *S. mutans* count. Guava essential oil also shows antimicrobial and anticancer activities.^[42]

23. Tomato (*Solanum lycopersicum*): Originally cultivated by Aztecs this vegetable is consumed globally. Its benefit in maintaining oral health has been mentioned in ayurvedic literature.

a. Active component: Lycopene, an acyclic isomer of beta-carotene, is found abundantly in tomato.

b. Mechanism of action: Lycopene has been linked to various dental benefits. Tomato, a potential natural teeth whitening agent due to its hydrogen peroxide and peroxidase enzyme content, helps in lightening tooth discoloration. Lycopene has anticarcinogenic properties. It interferes with the

lipid peroxidation process by inactivating free radicals, thereby preventing tissue damage. It suppresses carcinogen-induced phosphorylation of p53, Rb anti-oncogenes, and stops cell division at the G0-G1 cell cycle phase. It inhibits the proliferation of insulin-like growth factor, which results in a reduced rate of cell division. It also has immunomodulatory action by regulating T-cell differentiation.^[43]

c. Dental applications: Lycopene is also used to treat OSMF and leukoplakia. Lycopene reduces the duplication of abnormal fibroblasts and burning sensation in OSMF.^[44]

24. Sesame oil (*Sesamum indicum* L): Oldest cultivated oil seed crop dating back to 5000 years in India. It is primarily known for its role through oil pulling, a traditional Ayurvedic practice to promote oral health.

a. Active components: It is a rich source of vitamin E, antioxidants like sesamol, sesamin, sesamol, and omega-3 and omega-6 fatty acids.

b. Mechanism of action: When swished in the mouth, sesame oil undergoes a saponification method, where the oil is broken down by bicarbonates present in saliva and forms a soap that fights microorganisms and removes plaque.^[45]

c. Dental application: It inhibits the growth of *S. mutans* and *L. acidophilus*. It removes tartar, cures bad breath, strengthens gums, and improves sinus health.^[46]

25. Peppermint Oil (*Mentha piperita*): Peppermint oil/Pudina is a widespread herb cultivated in North & North Western India. It is known for its intense aroma and flavour.

a. Active component: It contains 48-55% menthol and 14-32% menthone.

b. Mechanism of action: It reduces bad breath, gingivitis, and dental caries by inhibiting *S. mutans* glucosyltransferases.^[47]

c. Dental applications: It is very often used in oral care products like toothpaste, mouthwash, and chewing gum.

26. Vajradanti (*Barleria prionitis*): - *Barleria prionitis* is an annual shrub belonging to the Family Acanthaceae; commonly known as Vajradanti and found throughout Africa, India, Sri Lanka and tropical Asia. The stem, leaves & flowers are used in traditional Indian medicines.

a. Active component: - Iridoids, phenolic acids, phenylethanoid glycosides lignans, flavonoids, and phytosterols.

b. Mechanism of actions: - The antimicrobial potency of plants is mainly due to tannins, saponins, phenolic compounds, essential oils and flavonoids. crude extracts from the bark of the *Barleria prionitis* may be used to treat the bacterial oral infections caused by *Bacillus* sp. and the oral fungal infections caused by *Candida albicans* and *Saccharomyces*.^[48]

c. Dental applications: - The leaves of Vajradanti are used for gum bleeding and

toothache.^[48]

Table 2: Medicinal Herbs in Dentistry – Active Components, Mechanisms, and Applications.

Herb (Botanical Name)	Active Component(s)	Mechanism of Action	Dental Application(s)
Neem (<i>Azadirachta indica</i>)	Nimbidin	Inhibits bacterial adhesion and plaque formation	Toothpaste, root canal irrigant, chewing sticks
Miswak (<i>Salvadora persica</i>)	Vitamin C, flavonoids, salvadorine	Disrupts bacterial metabolism, increases saliva, neutralizes acids	Antiplaque rinse, enamel strengthening, gingivitis control
Babool (<i>Acacia nilotica</i>)	Gallic acid, saponins, tannins	Antibacterial, antifungal properties	Root canal irrigant, dentifrice ingredient
Bakuchi (<i>Psoralea corylifolia</i>)	Bakuchiol, flavonoids	Disrupts membranes, reduces cytokine release	Root canal irrigant, treats autoimmune oral lesions
Turmeric (<i>Curcuma longa</i>)	Curcuminoids	Anti-inflammatory, antifibrotic, inhibits prostaglandin synthesis	Intracanal medicament, periodontitis, OSMF, dry socket management
Ginger (<i>Zingiber officinale</i>)	Gingerol	Antioxidant, anti-inflammatory, antitumor	Treats xerostomia, ulcers, dental caries
Garlic (<i>Allium sativum</i>)	Allicin	Destroys bacterial membranes, enhances antioxidant enzymes	Root canal irrigant, oral cancer prevention
Cinnamon (<i>C. zeylanicum</i>)	Cinnamaldehyde, eugenol	Antibacterial, disrupts membranes, biofilm inhibition	Gingivitis, aphthous stomatitis, GIC additive
Clove (<i>Syzygium aromaticum</i>)	Eugenol, flavonoids	Antimicrobial, analgesic via ion channel regulation	Anesthesia, halitosis, periodontitis
Aloe vera (<i>A. barbadensis</i>)	Anthraquinones, chromones	Immunomodulatory, anti-inflammatory, prostaglandin suppression	Ulcers, lichen planus, OSMF, periodontitis
Tulsi (<i>Ocimum sanctum</i>)	Eugenol, caryophyllene	Ruptures bacterial membranes, protein synthesis inhibition	Dentifrice, obturating material, gingivitis treatment
Noni (<i>Morinda citrifolia</i>)	Terpenes, flavonoids, alkaloids	Interferes with bacterial metabolism and quorum sensing	Periodontitis, bone regeneration, root canal disinfectant
Liquorice (<i>Glycyrrhiza glabra</i>)	Glabridin, flavonoids, phenols	Inhibits gene expression, acid production, and plaque formation	Oral candidiasis, ulcers
Ashwagandha (<i>Withania somnifera</i>)	Withanolides, alkaloids	Immune stimulation, bacterial lysis	Intracanal medicament, biofilm reduction
Myrrh (<i>Commiphora myrrh</i>)	Terpenoids, furanodienes	Enhances fibroblast proliferation, increases collagen synthesis	Gingivitis, extraction healing, oral ulcers
Propolis	Flavonoids, phenolics	Inhibits glucosyltransferase, bactericidal	Root canal irrigant, biofilm control, varnish, dry socket

Amla (<i>Emblica officinalis</i>)	Vitamin C, emblicanin, ellagic acid	Antioxidant, modulates inflammation	Periodontitis, oral ulcers, mouthwash
Triphala	Chebularic acid, gallic acid	Reduces <i>S. mutans</i> adhesion and growth	Caries control, periodontitis, root canal irrigant
Coconut (<i>Cocos nucifera</i>)	Cytokinins, antioxidants	Maintains PDL vitality, antibacterial	Storage medium for avulsed tooth
Papain (from Papaya)	Papain enzyme	Breaks degraded collagen only	Caries treatment, whitening gels
Guava (<i>Psidium guajava</i>)	Quercetin, tannins, flavonoids	Strengthens gums, antibacterial, antioxidant	Mouth rinse, anticancer, antigingivitis
Tomato (<i>Solanum lycopersicum</i>)	Lycopene	Antioxidant, modulates cell growth and immunity	OSMF, leukoplakia, whitening
Sesame oil (<i>S. indicum</i>)	Sesamol, omega fatty acids	Saponification, reduces plaque	Oil pulling, bad breath, tartar reduction
Peppermint (<i>Mentha piperita</i>)	Menthol, menthone	Inhibits <i>S. mutans</i> enzymes	Mouthwash, toothpaste, gum
Vajradanti (<i>Barleria prionitis</i>)	Tannins, flavonoids, saponins	Antibacterial against <i>Bacillus</i> and <i>Candida</i>	Treats bleeding gums, toothache

Adverse Effects

Although the use of medicinal plants is an emerging trend in dentistry, a few cases of side effects have been reported, including allergies and adverse effects on the gastrointestinal tract and central nervous system. Allergies, such as contact dermatitis, have also been associated with *E. purpurea*, *Allium sativum*, and Caraway. Long-term use of Sage can elevate heart rate and cause mental disorientation. Excessive consumption of liquorice root may result in hypokalemia, hypertension, rhabdomyolysis, muscle paralysis, respiratory impairment, hypertensive emergencies, hyperparathyroidism, encephalopathy, and acute renal failure. Local adverse reactions of aloe vera, such as redness and burning sensations, have been noted. Mild to severe systemic reactions like abdominal cramps, constipation, and hepatitis have also been noted. Prolonged use of aloe vera may enhance the chance of colorectal cancer.

Future Perspective

The acceptance of herbal medicine is rapidly increasing. The Ayurvedic drug market is estimated to be growing at a rate of 20% with Sales of herbal medications in India increasing by approximately 25% in the last ten years. The Ayurvedic Pharmacopoeia, brought out by the Government of India, recommends basic quality for 80 common Ayurvedic drugs.^[49]

Nanotechnology and Artificial intelligence can be used in Ayurveda to streamline research

protocols, identify medicinal plants, verify their authenticity, and optimize herb procurement.^[50]

CONCLUSION

The use of medicinal plants is expanding rapidly worldwide. This has made dentistry safer and more affordable. Its wide availability as an alternative medicine is making people more inclined towards it. However, more in vitro and in vivo studies with long-term follow-ups need to be conducted to compare the use of conventional drugs with phytomedicines.

As rightly stated by Robin Rose Bennet, “Mother earth’s medicine chest is full of healing herbs of incomparable worth” proper knowledge and application of the same is required for prescribing the herbal medicines in routine dental procedures.

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