Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 649-655 | ISSN:2251-6727

Phytotherapy in Endodontics: A Review

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(Received: 05 January 2026 Revised: 15 February 2026 Accepted: 05 March 2026)

KEYWORDS

Herbal endodontics,

Herbal medicines,

Phytotherapy

ABSTRACT:

The primary objective of root canal treatment is complete disinfection, but the persistence of residual bacteria and the potential for reinfection pose significant challenges. Conventional synthetic drugs are associated with limitations, including issues with their effectiveness, adverse side effects, and safety concerns, driving interest in herbal alternatives. Herbal options offer several advantages, such as biocompatibility, cost-effectiveness, ease of use, and strong antimicrobial, antioxidant, and anti-inflammatory properties. Furthermore, they present a reduced likelihood of inducing microbial resistance. However, their successful incorporation into clinical practice necessitates rigorous preclinical and clinical trials, evaluation of interactions with other materials, and an evaluation of potential detrimental effects. The increasing popularity of medicinal plants, particularly in India, underscores the potential of herbal extracts to address the limitations of synthetic drugs that can disrupt the oral microbiota.

1. Introduction

Root canal treatment in dentistry presents a formidable challenge because of the intricate anatomy of root canals and the requirement for effective disinfection. Traditional approaches using synthetic intracanal medicaments and irrigants like sodium hypochlorite, chlorhexidine, and ethylene diamine tetra acetic acid have raised concerns about their side effects and potential allergic reactions. [1]

Furthermore, intracanal medicaments like calcium hydroxide can weaken dentin through collagen breakdown, and triple antibiotic paste may lead to tooth discoloration and dentin demineralization.[2,3] To address these limitations, several biocompatible alternatives have been developed. Herbal products, with their rich reservoir of antimicrobial, antioxidant, anxiolytic, sedative, and anti-inflammatory properties, are emerging as promising agents for root canal disinfection.[1,2,3]

Herbal therapy has been described by the WHO as a plant-based composition or substance that consists of raw or processed elements from one or more plants that have medicinal properties.[4] The purpose of this review is to investigate the use of diverse herbal products in endodontics and to provide information on their efficacy, safety, and acceptability as substitutes for common intracanal medications and irrigants by investigating their attributes and modes of operation.

Principles of Herbal Endodontics: Antimicrobial Properties, Anti-inflammatory Effects, Tissue Regeneration, Biocompatibility

2. Different Herbal Agents in endodontics:

Propolis: Flavonoids, phenolics, and aromatics are the primary pharmacologically active components of propolis. Flavonoids are responsible for the major biological action of propolis.[5] Propolis demonstrates various physiological actions, including anti-

Journal of Chemical Health Risks
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JCHR (2026) 16(2), 649-655 | ISSN:2251-6727

inflammatory, antioxidant, antimicrobial, cytotoxic, and anaesthetic qualities.[6] The caffeic acid phenethyl ester (CAPE) in propolis is responsible for its anti-inflammatory property. Propolis ethanol extract is advantageous for endodontic use, as it promotes bone regeneration and boosts the creation of hard tissue bridges during pulpotomies or pulp capping.[7,8] It is used as a root canal irrigant, intracanal medicament, and storage medium for avulsed teeth to preserve the health of the periodontal ligament.[5,9,10]

Salvadora persica (Miswak): It is also known as the chewing stick or toothbrush tree. It contains significant amounts of trimethylamine, salvadorine, chloride, and fluoride. Its 15% alcoholic extracts exhibit potent antimicrobial properties.[11] It is a potential substitute for chlorhexidine and NaOCl in root canal irrigation.[12,13] The herbal mouthwash showed significant reductions in colony-forming units, similar to chlorhexidine, indicating its effectiveness for preoperative rinsing. [14] It also effectively removes the smear layer.[15]

Morinda citrifolia: Morinda citrifolia, commonly known as Noni or Indian Mulberry, is a tropical fruit indigenous to various regions that holds a significant place in folk medicine. This versatile fruit boasts a wide array of medicinal properties, including antibacterial, antiviral, anti-inflammatory, analgesic, antitumor, hypotensive, and immune-promoting effects. It has gained attention in endodontics as an effective natural remedy for dental treatments. Research has shown that Morinda citrifolia juice (MCJ) is a more effective endodontic irrigant compared to sodium hypochlorite when used in conjunction with EDTA. Its biocompatibility and antioxidant properties reduce the risk of hypochlorite accidents.[16] Its antibacterial attribute is due to the presence of L-asperuloside and alizarin, along with several other phytochemicals like lignans, oligopolysaccharides, flavonoids, and catechins.[1] It is also an efficient chelating agent.[17]

German Chamomile (Marticaria recutita L.): It is used primarily for its analgesic, anti-inflammatory, antispasmodic, antimicrobial, and sedative properties. In addition to being an ingredient in certain toothpastes, chamomile has been shown to be useful in treating mouth irritations, gingivitis, and mild infections.[16] The chamomile plant flower, a common ingredient of table tea, contains certain chemically active substances, like chamazulene, capric acid, caprylic acid, and chlorogenic acid. It has been proven to be more efficient than NaOCl in removing the smear layer.[18]

Tea Tree Oil (Melaleuca alternifolia): An indigenous Australian plant, Melaleuca alternifolia, is the source of oil with some outstanding qualities. Terpinen-4-ol, the oil's main active ingredient and the source of its significant antibacterial and antifungal properties, makes up 30–40% of the oil.[19] This oil has found applications as an antifungal and antiseptic agent, and even as a mild solvent. In the realm of endodontics, tea tree oil has been explored as an effective root canal irrigant, although it has been found to be less effective than both NaOCl and EDTA in this context. Nevertheless, it remains a valuable natural remedy for various ailments, including throat irritations, stings, burns, wounds, skin infections, and even periodontal tissue healing. Tea tree oil has established itself as a unique and efficient alternative for people seeking natural therapies with antifungal and antibacterial qualities.

Arctium lappa: An indigenous Brazilian plant with Japanese origins, Arctium lappa has gained widespread recognition in popular medicine for its diverse medicinal benefits. Notably, it possesses antibacterial, antifungal, diuretic, antioxidant, and anxiolytic actions, as well as a platelet anti-aggregating effect and potential HIV-inhibitory properties. In the field of dentistry, Arctium lappa has garnered attention for its potential antimicrobial effect against oral pathogens commonly associated with endodontic infections. [20] Due to the presence of ethyl acetate, it is used as an intracanal dressing and has been shown to prevent biofilm formation.

Triphala: An Ayurvedic herbal product, triphala contains the dehydrated and pulverized fruits of three different therapeutic plants: Terminalia bellerica (Bibhitaki), Terminalia chebula (Haritaki), and Emblica officinalis (Amalaki). The use of Triphala in research is complicated by its laborious extraction process, which necessitates fresh preparation before each use.[21] Due to its high citric acid content, it is an efficient chelating agent and can be used as an alternative to sodium

Journal of Chemical Health Risks
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JCHR (2026) 16(2), 649-655 | ISSN:2251-6727

hypochlorite for root canal irrigation.[22] Triphala has demonstrated a superior antibacterial effect on biofilms of Enterococcus faecalis.[23] Citric acid, tannins, quinones, flavonoids, gallic acid, and vitamin C in this formulation are responsible for removing the smear layer and preventing the growth of biofilm.[24]

Green Tea: Camellia sinensis leaves are utilized to make green tea, which is popular for its remarkable properties and health benefits. Its active compounds, known as polyphenols, particularly flavanols or catechins, have been extensively studied for their diverse therapeutic qualities. These polyphenols, also referred to as Green Tea Polyphenols (GTPs), showcase impressive antioxidant, anti-inflammatory, thermogenic, probiotic, and antimicrobial characteristics.[24,25] The leaves of Camellia sinensis are known to contain polyphenolic components that exhibit potent antimicrobial properties, effectively combating a wide spectrum of microbes.[26] These GTPs, especially gallocatechins, have been related to unfermented tea's antioxidant ability to combat free radicals. Additionally, the natural fluoride found in tea may help prevent dental caries, and both green and black teas include flavonoids that stop the activity and growth of microorganisms linked to tooth disease. Studies have demonstrated that green tea extracts, at various concentrations, can suppress the growth of bacteria like E. faecalis, demonstrating the effectiveness of the extract's antimicrobial properties, which are more pronounced at higher extract concentrations.[27] Thus, green tea's multifaceted properties make it a compelling choice as an antiplaque and chelating agent, offering a holistic approach to oral health.[26]

Azadirachta Indica: The Indian neem/margosa tree has garnered significant attention for its potential role in root canal irrigation, offering a promising alternative to sodium hypochlorite. This remarkable tree is renowned for its antioxidant properties and has demonstrated action against E. faecalis and Candida albicans, both common culprits in root canal infections.[28] Interestingly, research has shown that when compared to NaOCl and propolis, the Indian neem/margosa tree exhibits potent antimicrobial efficacy against C. albicans, making it a compelling candidate for combating fungal infections in root canals.[28,29] Studies have demonstrated that a combination of Indian neem extract and Aloe vera effectively decontaminates Gutta-percha (GP) cones, making it a potential disinfectant prior to root canal treatment. Additionally, the tree's ethanol extracts have shown promising results in the treatment of C. albicans and E. faecalis, leading to a multimodal strategy for root canal irrigation and disinfection.[17] These findings hold promise for improving the safety and efficacy of root canal procedures while reducing the reliance on traditional chemicals like sodium hypochlorite.

Aloe vera: Known for its remarkable properties, Aloe vera is a versatile plant with a rich chemical composition that makes it effective against various microbial threats. Aloe leaves consist of a clear gel surrounded by a green outer layer, with key chemical constituents such as aloins and barbadoins. This gel exhibits inhibitory effects on bacteria like Streptococcus pyogenes and Enterococcus faecalis due to the presence of anthraquinone. However, its bactericidal activity is found to be slightly less potent than calcium hydroxide.[30] Aloe Vera is rich in aloins, aloe-emodin, and anthraquinone, making it an effective antibacterial agent. Additionally, Aloe Vera contains minerals, vitamins, enzymes, sugars, saponins, lignin, salicylic acids, and amino acids, which contribute to its soothing, moisturizing, and healing properties. This remarkable plant finds applications in treating various conditions, including inflammation, infections, and lesions. Moreover, it can be used as a canal lubricant in endodontic procedures and as a decontaminant for dental GP cones, showcasing its diverse range of uses in both traditional and modern medicine.[30-34]

Orange Oil: Orange oil, synthesized in the glands within the fruit's rind, is primarily composed of d-limonene, along with aliphatic hydrocarbon alcohols and aldehydes like octanal. It is a safe and effective alternative to chloroform and xylene for softening gutta-percha and dissolving endodontic sealers during dental procedures.[35] Advantages include its harmlessness, low water solubility, and solubility in alcohol. Additionally, it has an expectorant function and is used in pharmaceuticals for flavor and fragrance. Xylene, according to a recent study, is the best solvent for removing specific dental sealers from root canals, although essential oils like eucalyptus oil and orange oil also work well. Orange oil stands out as an excellent,

Journal of Chemical Health Risks

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JCHR (2026) 16(2), 649-655 | ISSN:2251-6727

non-toxic alternative solvent for various dental applications, offering a safer and more efficient option compared to potentially harmful alternatives.[36,37]

Carvacrol: An organic substance with strong antibacterial capabilities, carvacrol can be found in the essential oils of many different plants, including Origanum vulgare, thyme, pepperwort, bergamot, and Satureja khuzistanica jamsizad oil (SKJ oil). This bioactive compound has been shown to exert inhibitory effects on bacterial strains like Escherichia coli (E. coli) and Pseudomonas aeruginosa (P. aeruginosa). Its antimicrobial activity is attributed to its multi-targeted action within bacterial cells, including disruption of the bacterial cell membrane. Additionally, Carvacrol is a viable option for endodontics, as it plays a significant role in stimulating pulpal fibers and healing periapical tissues, a process known as hormesis.[38,39]

Lemon Solution: Citric acid (pH 1.68) can be found naturally in lemon solution (pH 2.21). Fresh lemon solution is employed as a root canal medicament because it is highly effective against a variety of pathogens, including E. coli. Citric acid, which is abundant in limes and works well to remove the smear layer, has chelating properties. Its antimicrobial qualities make it an ideal root canal medicament without any harmful effects.[40]

Garlic (Allium sativum): Allicin is the primary active ingredient in garlic. It regulates the immune system and has antimicrobial properties. It can be used as an alternative to NaOCl as an irrigant because it breaks down the cell walls and membranes of root canal bacteria.[41]

Rhus plants: Rhus contains tannins, tannic acid, and gallic acid. Tannins have antifungal and antibacterial effects. Gallic acid is a powerful antioxidant and has bactericidal properties. It also reduces periapical inflammation. The water extract of Rhus plants helps in opening blocked dentinal tubules.[41]

Jieeryin Solution: This herbal compound is entirely of Chinese origin and possesses properties such as heat reduction, detoxification, antibacterial, and anti-inflammatory effects. It is utilized in root canal irrigation alongside ultrasonics, where it demonstrates its efficacy in combating anaerobic bacteria. Interestingly, a 30% concentration of this compound exhibits an effect comparable to that of NaOCl.[41]

Psoralea corylifolia: Bakuchiol, derived from Psoralea corylifolia seeds, exhibited bactericidal effects against a variety of bacteria, including Streptococcus mutans, Streptococcus sanguis, Streptococcus salivarius, Streptococcus sobrinus, E. faecalis, Enterococcus faecium, and Lactobacillus acidophilus. The lowest inhibitory doses were between 1 and 4 µg/ml.[42]

Psidium guajava: The plant commonly referred to as guava is renowned for its ability to inhibit the growth of two bacteria, S. mutans and S. aureus, which contribute to plaque formation. Guava leaves are rich in valuable components such as guaijaverin, vitamins, phenolic compounds, sesquiterpene alcohols, cineol, tannins, triterpenes, and flavonoids. Psidium guajava is also abundant in carotenoids like beta-carotene, lycopene, and beta-cryptoxanthin, as well as Vitamin C and polyphenols. With its diverse range of constituents, guava presents a potent option for addressing E. faecalis, and it possesses various beneficial properties including anti-inflammatory, antibacterial, antioxidant, and antimutagenic activities, among others.[43]

Punica granatum: Rich in anthocyanins, ascorbic acid, ellagic acid, quercetin, flavonoids, epigallocatechin, gallic acid, amino acids, and caffeic acids, this substance exhibits potent antioxidant and antimicrobial characteristics. It proves to be exceptionally efficacious in addressing conditions like gingivitis, ulcers, and aphthous stomatitis, and in combating periodontal pathogens.[44]

Syzygium aromaticum (Clove Tree): Clove is renowned for its antioxidative, antibacterial, and antimicrobial properties. Additionally, clove oil has a soothing impact on pulp inflammation.[44]

Turmeric: Throughout history, turmeric has enjoyed broad usage due to its antibacterial, antimicrobial, anti-inflammatory, and antiseptic qualities. It is commonly applied to regions afflicted with injuries, cuts, toothaches, or swelling.[45]

Cranberry: In ancient times, cranberries were used to alleviate stomach issues, scurvy, and liver ailments. They are rich in polyphenols and flavonoids and have proven effective in combating dental caries. Cranberries

Journal of Chemical Health Risks

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JCHR (2026) 16(2), 649-655 | ISSN:2251-6727

also exhibit antibacterial and antimicrobial properties, which contribute to inhibiting the growth of various pathogens and biofilms.[31]

Acacia nilotica: With its high content of tannins and phenolic compounds, it is well-suited for the treatment of E. faecalis, showcasing its antimicrobial qualities.[44]

Casearia sylvestris: Due to its abundance of phospholipase A2 inhibitors, it is an excellent choice as an anti-inflammatory intracanal medicament.[9]

Advantages of Herbal Endodontics includes: Reduced Side Effects, Sustainable Approach, Potential for Regeneration, Ease of availability, Low cost, Lack of microbial tolerance

Challenges and Considerations: Limited Clinical Evidence and Standardization

Future directions: In the field of endodontics, herbs and natural remedies are employed to reduce inflammation and alleviate tissue irritation. It is essential to conduct preclinical and clinical trials, assess interactions with other materials, and consider potential adverse effects when utilizing these herbal products. There is still a significant amount to be learned about the potential applications of nature and its products within the dental profession. These herbal treatments can offer benefits, particularly in countries where a majority of the population may not have access to expensive therapies. However, additional research is necessary before they can be integrated into standard endodontic procedures.

3. Conclusion:

The utilization of herbal extracts and natural compounds has shown promising antimicrobial, anti-inflammatory, and regenerative properties, making them attractive alternatives or adjuncts to conventional endodontic treatments. While the field of herbal endodontics holds great promise, further research is essential to validate the efficacy, safety, and standardized protocols for their clinical application. As we continue to explore the potential of herbal remedies, their integration into endodontic practice may offer a more holistic and patient-friendly approach, ultimately enhancing the quality of endodontic care.

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