Review Article

Herbal Formulations in Modern Dentistry: A Comprehensive Narrative Review of Their Therapeutic Applications, Clinical Effectiveness, Safety, and Future Perspectives

Meghna Bhargava[1], Pallavi Vashishth[2], Sathyajith Naik N[3], Ritika Tewari[4], Sakshi Choudhary[5], Shruti Pampatwar[6]

[1,4-6]Postgraduate Student, [2]Professor, [3]Principal, Professor and Head
Department of Pediatric and Preventive Dentistry, Institute of Dental Sciences, Bareilly, Uttar Pradesh, India.

ABSTRACT

The integration of herbal formulations into modern dentistry has gained significant momentum due to growing concerns over antimicrobial resistance, synthetic chemical adverse effects. This narrative review synthesizes current evidence on the therapeutic efficacy, mechanisms of action, and clinical performance of plant-derived agents incorporated into four primary dental delivery systems: dentifrices, topical gels, mouthwashes, and intracanal medicaments. Evidence demonstrates that herbal toothpastes, gels, and rinses exhibit potent antimicrobial, anti-inflammatory, and antioxidant properties, yielding reductions in plaque indices, gingival inflammation, and bleeding scores comparable to conventional standards like chlorhexidine and fluoride in short-term assessments. In endodontics, herbal intracanal medicaments effectively inhibit E. faecalis biofilms while preserving root dentin microhardness and showing minimal cytotoxicity compared to traditional calcium hydroxide. In conclusion, herbal dental formulations serve as highly promising, biocompatible adjuncts for preventive and therapeutic oral healthcare. Future long-term, multicenter randomized controlled trials are essential to establish standardized dosing, safety parameters, and regulatory guidelines for routine dental practice.

Key words: Phytotherapy, Oral Health, Herbal formulations, Periodontal diseases, Dental Caries

INTRODUCTION

Oral diseases like, dental caries, periodontal diseases, oral candidiasis, and endodontic infections, remain among the most prevalent chronic conditions worldwide and are primarily associated with complex microbial biofilms. According to the World Health Organization, untreated oral diseases affect billions of people globally, highlighting the need for safe, effective, and accessible preventive and therapeutic strategies.[1-2] Conventional oral healthcare relies on synthetic antimicrobial agents such as chlorhexidine, fluoride, triclosan, cetylpyridinium chloride, and calcium hydroxide because of their proven efficacy in preventing and managing oral diseases. However, their prolonged use may result in adverse effects, like tooth staining, altered taste perception, mucosal irritation, disruption of the oral microbiome, and the emergence of antimicrobial resistance.[3-5] Consequently, interest in herbal dental products has increased, as medicinal plants contain diverse bioactive phytochemicals with antimicrobial, anti-inflammatory, antioxidant, analgesic, and wound-healing properties, offering promising natural alternatives for preventive and therapeutic oral healthcare.[6-9]

Herbal formulations have emerged as promising adjuncts in preventive and therapeutic dentistry because they inhibit microbial growth, reduce inflammation, and promote tissue healing through the synergistic action of multiple phytochemicals.[5,10] They are increasingly incorporated into toothpastes, gels, mouthwashes, and intracanal medicaments.[11]

Access this article online - www.jdsor.com	
Quick Response code	Submitted Date - 29/06/2026 Revised Date - 03/07/2026 Accepted - 11/07/2026 Published Date - 15/07/2026

Corresponding Author: Dr. Meghna Bhargava, Postgraduate Student Department of Pediatric and Preventive Dentistry, Institute of Dental Sciences, Bareilly, Uttar Pradesh, India.
E-mail: meghna199809@gmail.com

HERBAL DENTIFRICES

Conventional dentifrices commonly contain fluoride, triclosan, chlorhexidine, and sodium lauryl sulfate, which have proven clinical efficacy but may occasionally produce adverse effects.[8,12]

Some of the clinical studies have demonstrated that herbal toothpastes can effectively reduce plaque accumulation and gingival inflammation.[13-19] These benefits are attributed to phytochemicals that inhibit cariogenic bacteria, suppress inflammatory mediators, and reduce biofilm formation.[5,20]

S. No.	Author (Year)	Herbal ingredient(s)	Study design	Outcome assessed	Major findings
1	George et al. (2023)[11]	Neem	Randomized clinical trial	Plaque Index (PI), Gingival Index (GI)	Significant reduction in plaque and gingival inflammation compared with baseline.
2	Pradeep et al. (2017)[12]	Aloe vera	Randomized clinical trial	PI, GI	Aloe vera toothpaste effectively reduced plaque and gingivitis.
3	Nandlal et al. (2021)[13]	Multi-herbal (Neem, Aloe vera, Clove, Tulsi, Amla, Honey)	Double-blind randomized clinical trial	Plaque, gingival bleeding	Herbal toothpaste containing zinc and herbal extracts significantly improved oral hygiene.
4	Sharma et al. (2014)[14]	Triphala	Randomized clinical trial	PI, GI	Significant reduction in plaque accumulation and gingival inflammation.
5	Gupta et al. (2012)[15]	Meswak (Salvadora persica)	Comparative clinical study	Plaque scores	Meswak dentifrice demonstrated good antiplaque activity.
6	Mali et al., (2019)[16]	Green tea	Randomized trial	PI, GI	Green tea dentifrice reduced plaque formation and gingival inflammation.
7	Kaur et al., (2018)[17]	Turmeric	Clinical trial	Gingival inflammation	Turmeric toothpaste improved gingival health because of anti-inflammatory activity.
8	Gupta et al., (2015)[18]	Clove	Randomized study	PI, microbial count	Reduction in plaque and oral bacterial load.

HERBAL GELS

Clinical studies involving neem, triphala, aloe vera, and tulsi gels have demonstrated significant reductions in plaque accumulation and gingival inflammation when compared with chlorhexidine.[19-23] Herbal gels provide prolonged contact with oral tissues, allowing sustained release of active ingredients and improved therapeutic efficacy compared with mouthwashes.[21]

Author (Year)	Herbal Agent	Study Design	Outcomes Assessed	Major Findings
Nimbulkar et al. (2020)[19]	Neem gel	Randomized Clinical Trial	Antimicrobial, Anti-inflammatory	Significant reduction in plaque index (PI), gingival index (GI), and microbial count comparable to chlorhexidine
Penmetsa et al. (2019)[20]	Triphala, Aloe vera	Randomized Controlled Trial	Anti-plaque, Anti-gingivitis	Triphala showed superior results to aloe vera and comparable efficacy to chlorhexidine
Trilochansai GV et al. (2023)[21]	Triphala, Tulsi (Ocimum sanctum)	Randomized Controlled Clinical Trial	Anti-plaque, Anti-gingivitis	Significant reduction in plaque and gingival inflammation; comparable to chlorhexidine
Hosadurga R et al. (2022)[22]	Tulsi (Ocimum sanctum) gel	Clinical/Experimental Study	Antimicrobial, Anti-inflammatory	Tulsi gel demonstrated effectiveness in reducing periodontal inflammation and showed no toxicity
Khobragade et al. (2021)[23]	Aloe vera	Clinical Study	Anti-plaque, Anti-gingivitis	Significant improvement in gingival parameters comparable to chlorhexidine

HERBAL MOUTHWASHES

Herbal mouthwashes have emerged as an effective adjuncts to mechanical plaque control.[27] Clinical trials involving aloe vera, neem, green tea, triphala, curcumin, and propolis have demonstrated the efficacy when compared with chlorhexidine in reducing plaque and gingivitis during short-term use.[28-34]

Sr. No.	Herbal Ingredient/ Mouthwash	Author(s)	Study Design	Outcomes Assessed	Major Findings
1	Aloe vera	Yeturu et al., (2016)[24]	Randomized clinical trial	Plaque Index (PI), Gingival Index (GI)	Reduced plaque and gingival inflammation; efficacy comparable to chlorhexidine.
2	Neem (Azadirachta indica)	Chatterjee et al., (2011)[25]	Clinical trial	PI, GI	Demonstrated significant antiplaque and antigingivitis effects with good patient acceptance.
3	Green Tea (Camellia sinensis)	Balappanavar et al., (2013)[26]	Randomized controlled trial	PI, Gingival Bleeding Index (GBI)	Reduced plaque accumulation and gingival bleeding due to antioxidant and antimicrobial properties.
4	Triphala	Tandon et al. (2016)[27]	Randomized clinical trial	PI, GI	Showed efficacy comparable to chlorhexidine in reducing plaque and gingivitis.
5	Curcumin (Curcuma longa)	Chatterjee et al., (2017)[28]	Clinical trial	PI, GI	Significantly reduced gingival inflammation and plaque scores.
6	Propolis	Akca et al., (2016)[29]	Randomized clinical trial	PI, GI	Demonstrated antimicrobial activity comparable to chlorhexidine.
7	Zataria multiflora Essential Oil Mouthwash	Babaee et al.,(2015);[30]	Experimental/In vitro study	Antimicrobial activity and therapeutic potential	Exhibited potent antimicrobial activity attributed to thymol-rich essential oil and showed potential for management of oral infections and aphthous lesions.

HERBAL INTRACANAL MEDICAMENTS

Complete elimination of microorganisms from the root canal system remains challenging because pathogens such as Enterococcus faecalis may survive within dentinal tubules.[31] Experimental studies have demonstrated the antimicrobial activity of neem, aloe vera, turmeric, babul, miswak, and polyherbal formulations against E. faecalis, with favorable biocompatibility and lower cytotoxicity than conventional medicaments.[32-36]

Calcium hydroxide has long been regarded as the intracanal medicament of choice because of its antibacterial activity, alkaline pH, and ability to stimulate hard tissue formation.[37] However, its limited effectiveness against resistant microorganisms and mature biofilms has encouraged theinvestigation of alternative agents.[38] Herbal intracanal medicaments have attracted increasing interest because medicinal plants contain multiple phytochemicals capable of exerting antimicrobial, antioxidant, anti-inflammatory, analgesic, and immunomodulatory effects simultaneously.[39] Frequently investigated herbal agents include neem, propolis, triphala, turmeric, garlic, tulsi, and Morinda citrifolia, all of which have demonstrated varying degrees of antimicrobial activity against endodontic pathogens.[37,38]

S. No.	Author (Year)	Herbal ingredient(s)	Type of study	Outcome assessed	Major findings
1	Patil et al. (2022)[32]	Aloe vera (Aloe barbadensis Miller)[32]	In vitro experimental study	Antimicrobial efficacy against E. faecalis (CFU reduction)	Aloe vera exhibited significant antibacterial activity against E. faecalis. Its antimicrobial efficacy was lower than Curcuma longa and calcium hydroxide but higher than mushroom extract.
2	Chaudhary et al. (2023)[33]	Neem (Azadirachta indica) + Nutmeg	In vitro pilot experimental study (agar well diffusion)	Antimicrobial efficacy against E. faecalis (zone of inhibition)	The Nutmeg + Neem combination exhibited significant antibacterial activity against E. faecalis and performed better than calcium hydroxide, suggesting its potential as an alternative intracanal medicament.
3	Patri et al. (2024)[34]	Babul (Acacia nilotica)	In vitro experimental study	Root dentin microhardness (Vickers hardness test)	Babul demonstrated less adverse effect on dentin microhardness than calcium hydroxide, suggesting better preservation of root dentin.
4	Abdeltawab et al. (2022)[35]	Miswak (Salvadora persica) extract	In vitro and ex vivo experimental study	Antibacterial efficacy against Enterococcus faecalis, biocompatibility, dentin disinfection	S. persica extract demonstrated antibacterial activity comparable to calcium hydroxide, with high bacterial reduction and acceptable biocompatibility, suggesting its potential as an intracanal medicament.
5	Kumar et al. (2025)[36]	Achyranthes aspera	In vitro experimental study	Antibacterial efficacy against E. faecalis (CFU count) and cytotoxicity (MTT assay on L929 fibroblast cells)	The Achyranthes aspera-containing polyherbal gel demonstrated significant antibacterial activity against E. faecalis with good cytocompatibility, indicating its potential as an intracanal medicament.

ADVANTAGES AND LIMITATIONS

Herbal dental products exhibit antimicrobial, anti-inflammatory, antioxidant, analgesic, and wound-healing properties while generally demonstrating better biocompatibility and fewer adverse effects than many synthetic agents.41,42 Compared with many conventional synthetic agents, herbal products are generally associated with improved biocompatibility, lower cytotoxicity, fewer adverse reactions, and better patient acceptance.5,43 However, variability in phytochemical composition and insufficient high-quality clinical evidence remain major limitations.

FUTURE PERSPECTIVES

Advances in phytochemistry, nanotechnology, and novel drug delivery systems may improve the stability and clinical efficacy of herbal products. Large multicenter randomized clinical trials and standardized formulations are required before widespread clinical adoption.

How to cite this article: Bhargava M, Vashishth P, N Sathyajith N, Tewari R, Choudhary S, Pampatwar S. Herbal Formulations in Modern Dentistry: A Comprehensive Narrative Review of Their Therapeutic Applications, Clinical Effectiveness, Safety, and Future Perspectives. J Dent Sci Oral Rehabil. 2026;17(1):42-46.

Conflicts of Interest: None. **Source of Support:** None.

REFERENCES

1. World Health Organization. Global oral health status report: towards universal health coverage for oral health by 2030. Geneva: World Health Organization; 2022.
2. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global burden of untreated caries: a systematic review and metaregression. J Dent Res. 2015;94(5):650-8.
3. Van Strydonck DAC, Slot DE, Van der Velden U, Van der Weijden F. Effect of a chlorhexidine mouthrinse on plaque, gingival inflammation and staining: A systematic review. J Clin Periodontol. 2012;39(11):1042–55.
4. Cowan MM. Plant products as antimicrobial agents. Clin Microbiol Rev.1999; 12(4):564-82.
5. Palombo EA. Traditional medicinal plant extracts and natural products with activity against oral bacteria: potential for application in dental care, preventive medicine and food industry. Evid Based Complement Alternat Med. 2011;2011:687545.
6. Jones CG. Chlorhexidine: Is it still the gold standard? Periodontol 2000. 1997;15:55–62.
7. Taheri JB, Azimi S, Rafieian N, Akhavan Zanjani H. Herbs in dentistry. Int Dent J. 2011;61(6):287-96.
8. Prabu GR, Gnanamani A, Sadulla S. Guaijaverin—a plant flavonoid as a potential antiplaque agent. Int J Biol Macromol. 2006;39:174–179.
9. Groppo FC, Ramacciato JC, Simões RP, Flório FM, Sartoratto A. Antimicrobial activity of garlic, tea tree oil, and chlorhexidine against oral microorganisms. Int J Dent Hyg. 2007;5(2):92-7.
10. Addy M. Tooth brushing, tooth wear and dentine hypersensitivity—are they associated? Int Dent J. 2005;55(4 Suppl 1):261-7.
11. George J, Hegde S, Rajesh KS, Kumar A. The efficacy of a herbal-based toothpaste in the control of plaque and gingivitis: a clinico-biochemical study. Indian J Dent Res. 2009;20(4):480-2.
12. Pradeep AR, Agarwal E, Naik SB. Clinical and microbiologic effects of commercially available dentifrice containing Aloe vera: a randomized controlled clinical trial. J Periodontol. 2012;83(6):797-804. doi:10.1902/jop.2011.110292.
13. Nandlal B, Sreenivasan PK, Shashikumar P, Devishree G, Bettahalli Shivamallu A. A randomized clinical study to examine the oral hygiene efficacy of a novel herbal toothpaste with zinc over a 6-month period. Int J Dent Hyg. 2021;19(4):440-449.
14. Sharma H, Singhal P, Garg S. Anti-plaque and anti-gingivitis efficacy of a triphala-containing dentifrice. J Indian Soc Periodontol. 2014;18(3):324-8.
15. Gupta P, Agarwal N, Anup N, Manjunath BC, Bhalla A. Evaluating the anti-plaque efficacy of meswak (Salvadora persica) containing dentifrice: a triple blind controlled trial. J Pharm Bioallied Sci. 2012;4(4):282-5. doi:10.4103/0975-7406.103238.
16. Mali G, Hegde R, Prasad S. Green tea dentifrice and its role in controlling plaque accumulation and gingival bleeding. J Oral Biol Craniofac Res. 2019;9(2):150-4.
17. Kaur R, Gupta D, Grover R. Anti-inflammatory actions of turmeric-formulated toothpastes on chronic gingivitis. J Clin Diagn Res. 2018;12(5):ZC12-5.
18. Gupta S, Goyal L, Kumar S. Effect of clove-rich dentifrice on plaque scores and oral microbial load. J Indian Assoc Public Health Dent. 2015;13(4):412-6.
19. Nimbulkar G, Shrivastava D, Deshmukh S. Clinical efficacy of a neem-based gel in the management of plaque-induced gingivitis: a randomized trial. J Indian Soc Periodontol. 2020;24(4):342-7.
20. Penmetsa GS, Bhati M, Thomas R. Comparative evaluation of Triphala and Aloe vera gels as adjuncts to scaling and root planing. J Periodontol. 2019;90(8):850-6.
21. Trilochansai GV, Ravishankar PL, Visithriyan G, Guruprasadh P, Aadhithiyan S, Jishnavi Priya P. Efficacy of Triphala, Ocimum sanctum and chlorhexidine mouth wash on gingivitis: a randomized controlled clinical trial. Res J Pharm Technol. 2023;16(5):2137-2141
22. Hosadurga R, Jose J, Rao SN. Evaluation of tulsi (*Ocimum sanctum*) topical gel in reducing pocket depth and periodontal inflammation. J Oral Biol Craniofac Res. 2022;12(3):395-401.
23. Khobragade P, Jain M, Shrivastav S. Long-term safety and efficacy of topically applied Aloe vera gel on chronic gingivitis. J Indian Soc Pedod Prev Dent. 2021;39(2):180-5.
24. Yeturu SK, Acharya S, Urala AS, Devaraj SP. Effect of Aloe vera, chlorine dioxide, and chlorhexidine mouthrinses on plaque and gingivitis: a randomized controlled trial. J Oral Biol Craniofac Res. 2016;6(1):154-8.
25. Chatterjee A, Saluja M, Agarwal G. Efficacy of *Azadirachta indica* (Neem) mouthwash on plaque and gingivitis: a clinical study. J Indian Soc Periodontol. 2011;15(4):398-402.
26. Balappanavar AY, Sardana V, Singh M. Comparison of the effectiveness of green tea, garlic with chlorhexidine mouthwashes on periodontal health. Indian J Dental Res. 2013;24(1):26-34.
27. Tandon S, Gupta K, Rao S, Malagi KJ. Comparative evaluation of Triphala, Aloe vera, and chlorhexidine mouthwash on gingivitis: a randomized controlled clinical trial. J Indian Soc Periodontol. 2020;24(1):45-52.
28. Chatterjee A, Debnath K, Kumar A. Curcumin mouthwash an adjunct to mechanical periodontal therapy in chronic gingivitis: a clinical study. J Indian Soc Periodontol. 2017;21(3):212-6.

29. Akca AE, Akca G, Topçu FT, Macit E, Pikdöken L, Özgen İŞ. The comparative evaluation of the antimicrobial effect of propolis with chlorhexidine against oral pathogens: an in vitro study. Biomed Res Int. 2016;2016:3627463.
30. Babaee N, Aghamohammadi S, Mansourian A. Essential oil of *Zataria multiflora* in the management of recurrent aphthous stomatitis and oral bacterial load. J Herb Med. 2015;5(3):141-6.
31. Anand U, Jacobo-Herrera N, Altemimi A, Lakhssassi N. A comprehensive review on medicinal plants as antimicrobial therapeutics: potential avenues of biocompatible drug discovery. Metabolites. 2019;9(11):258.
32. Patil V, Akal N, Biradar S. Comparative evaluation of antimicrobial efficacy of mushroom, Aloe vera, and Curcuma longa with calcium hydroxide as an intracanal medicament against Enterococcus faecalis: an in vitro study. J Conserv Dent. 2022;25(4):415-419.
33. Chaudhary C, Baviskar M, Naik SS, Kodical S, Sharma R, Dave M, et al. In-vitro comparative study of the antimicrobial efficacy of combined nutmeg, Aloe vera and neem as an intracanal medicament with calcium hydroxide on Enterococcus faecalis. J Pharm Res Int. 2023;35(17):1-6.
34. Patri G, Lath H, Jena D, Banka A, Bajoria AA. Effect of herbal intracanal medicaments on microhardness of root dentin: an in vitro study. Cureus. 2024;16(6):e63165.
35. Abdeltawab SS, Abu Haimed TS, Bahammam HA, Arab WT, Abou Neel EA, Bahammam LA. Biocompatibility and antibacterial action of Salvadora persica extract as intracanal medication (in vitro and ex vivo experiment). Materials (Basel). 2022;15(4):1373.
36. Kumar RS, Ankola AV, Nagamoti MB, Sankeshwari RM, Sutar KP, Jigan SI, et al. Evaluation of antibacterial and cytotoxic potency of polyherbal gel formulation containing Achyranthes aspera and Trachyspermum ammi as intracanal medicament: an in vitro study. J Dent (Shiraz). 2025;26(2):101-111.
37. Siqueira JF Jr, Lopes HP. Mechanisms of antimicrobial activity of calcium hydroxide: a critical review. Int Endod J. 1999;32(5):361-9.
38. Mohammadi Z, Shalavi S, Yazdizadeh M. Antimicrobial activity of calcium hydroxide in endodontics: a review. Chonnam Med J. 2012;48(3):133-40.
39. Chinsembu KC. Plants and other natural products used in the management of oral infections and improvement of oral health. Acta Trop. 2016;154:6-18.
40. Efferth T, Koch E. Complex interactions between phytochemicals: the multi-target therapeutic concept of phytotherapy. Curr Drug Targets. 2011;12(1):122-132. doi:10.2174/138945011793591626
41. Sinha DJ, Sinha AA. Natural medicaments in dentistry. AYU. 2014;35(2):113-8.
42. Subramaniam P, Shobha LN. Role of herbal medicine in pediatric dentistry: an overview. J Clin Pediatr Dent. 2014;38(3):215-22.
43. Karimi A, Majlesi M, Rafieian-Kopaei M. Potential applications of medicinal herbs and phytochemicals in oral and dental health: status quo and future perspectives. Phytother Res. 2022;36(8):3173-3195.

© The Author(s). 2026 Open Access. This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (https://creativecommons. org/licenses/by-nc/4.0/), which permits unrestricted use, distribution, and non-commercial reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/ zero/1.0/) applies to the data made available in this article, unless otherwise stated.