RESEARCH PAPER

Revisiting Herbal Endodontics: The Role of Propolis Against Enterococcus faecalis as an Intracanal Medicament — A Systematic Review

Authors

Dr. Mudit Uppal[1*], Dr. Gurleen Arora[2]

[1]Assistant Professor, Department of Restorative Dental Sciences, College of Dentistry, Mustaqbal University, Buraydha, Saudi Arabia

[2]Assistant Professor, Department of Prosthodontics, Ramy Dental Clinic, Buraydha, Saudi Arabia

***Corresponding Author: Dr. Mudit Uppal, Assistant Professor, Department of Restorative Dental Sciences, College of Dentistry, Mustaqbal University, Buraydha, Saudi Arabia**

Email: uppal_mudit1@yahoo.com.in

Abstract

Background: Enterococcus faecalis is among the most commonly identified bacteria linked to recurrent endodontic infections and failures in root canal treatment. The capacity to endure extreme climatic conditions, infiltrate dentinal tubules, and establish resilient biofilms diminishes the efficacy of traditional intracanal medicaments such calcium hydroxide. Propolis, a natural resinous substance sourced from honeybees, has garnered interest in recent years due to its antibacterial, anti-inflammatory, and antibiofilm characteristics.

Aim: This systematic review sought to assess the antibacterial efficiency of propolis against Enterococcus faecalis when utilised as an intracanal medicament and to compare its effectiveness with traditional endodontic medicaments.

Materials and Methods: A systematic literature search was performed in accordance with PRISMA standards utilising the PubMed, Scopus, Google Scholar, Web of Science, and ScienceDirect databases for publications published from 2006 to 2026. Studies assessing propolis as an intracanal medicament against E. faecalis were included. Information pertaining to study design, propolis formulation, comparison groups, microbiological evaluation techniques, and outcomes was retrieved and subjected to qualitative analysis. The assessment of bias risk was conducted based on methodological quality, randomisation, microbiological standardisation, blinding, and statistical analysis.

Results: Thirteen studies were used into the qualitative synthesis. Numerous investigations have shown substantial antibacterial efficacy of propolis against E. faecalis. Numerous studies indicated that propolis demonstrated greater or equivalent effectiveness to calcium hydroxide. Madhubala et al. documented total bacterial eradication with propolis after two days, with investigations indicating markedly reduced colony-forming units and minimum inhibitory concentration values in comparison to calcium hydroxide ($p<0.001$). Propolis formulations with nanoparticles demonstrated improved penetration and antibiofilm efficacy. Combination therapy utilising propolis alongside antibiotics or calcium hydroxide exhibited synergistic antibacterial properties. Nonetheless, methodological variability among studies and the prevalence of in vitro research constrained direct outcome comparisons.

Conclusion: Propolis exhibited significant antibacterial and antibiofilm properties against Enterococcus faecalis and may function as a viable natural intracanal medicament in endodontic treatment. Its efficiency was often comparable to or higher than that of calcium hydroxide, with the added benefits of biocompatibility and natural origin. However, additional standardised clinical investigations and randomised controlled trials are necessary to determine appropriate formulations, concentrations, and long-term clinical efficacy.

Keywords: Propolis; *Enterococcus faecalis*; Intracanal medicament; Endodontics; Root canal disinfection; Calcium hydroxide; Antibacterial activity; Biofilm; Herbal endodontics; Nanoparticles.

How to cite this article: Uppal M, Arora G. Revisiting Herbal Endodontics: The Role of Propolis Against Enterococcus faecalis as an Intracanal Medicament — A Systematic Review. Int J Drug Deliv Technol. 2026;16(55s): 1495-1505. DOI: 10.25258/ijddt.16.55s.157

Introduction

The efficacy of endodontic treatment is predominantly contingent upon the thorough eradication of germs from the root canal system and the prevention of reinfection. Nonetheless, the intricate structure of root canals, encompassing accessory canals, fins, isthmuses, and dentinal tubules, renders full disinfection just through mechanical instrumentation and irrigation

challenging to accomplish [1]. Residual germs residing in these inaccessible regions are regarded as a primary factor contributing to chronic periapical infections and the failure of endodontic therapy. Enterococcus faecalis is the most commonly isolated bacterium linked to unsuccessful root canal therapy [2]. This Gram-positive facultative anaerobe may endure extreme environmental conditions, infiltrate dentinal tubules, withstand nutritional scarcity, resist elevated alkaline pH, and build biofilms, rendering it notably resistant to standard intracanal medicaments [3].

Intracanal medicaments are utilised between treatment sessions to improve root canal disinfection and eradicate leftover bacteria. Calcium hydroxide has always been considered the benchmark intracanal medicament due to its antimicrobial properties and elevated pH. Nonetheless, other investigations have indicated the restricted efficacy of calcium hydroxide against E. faecalis, primarily attributable to the buffering capacity of dentin and the organism's resilience to alkaline environments [3,4]. This constraint has prompted the exploration of alternate intracanal medicaments with enhanced antibacterial effectiveness and biocompatibility.

Recently, there has been a growing focus on herbal and natural medicines in endodontics due to their extensive antibacterial characteristics, diminished toxicity, biocompatibility, and reduced likelihood of antimicrobial resistance [5]. Propolis has emerged as a promising intracanal medicament among these natural agents. Propolis is a resinous material gathered by honeybees from plant exudates, combined with wax and bee enzymes. It comprises several physiologically active chemicals, including as flavonoids, phenolic acids, terpenoids, aromatic aldehydes, and esters, which enhance its antibacterial, anti-inflammatory, antioxidant, antifungal, and immunomodulatory attributes.

Multiple in vitro investigations have examined the antibacterial effectiveness of propolis against E. faecalis. Oncag et al [7]. were pioneers in demonstrating that propolis displayed notable antibacterial efficacy against E. faecalis in infected root canals, indicating its potential as an alternative intracanal medicament. Madhubala et al [4]. investigated propolis, calcium hydroxide, and a triantibiotic combination, finding that propolis attained total bacterial eradication within two days and had superior antibacterial activity compared to calcium hydroxide. Zare Jahromi et al [1]. demonstrated that propolis exhibited markedly reduced colony-forming units and minimum inhibitory concentrations in comparison to calcium hydroxide, signifying its higher antibacterial efficacy against E. faecalis.

Subsequent research has corroborated these findings. Ahangari et al [8]. established that the antimicrobial efficacy of propolis was equivalent to that of calcium hydroxide across various time intervals, whereas Shrivastava et al [9]. indicated that propolis, either independently or in conjunction with antibiotics like moxifloxacin and ciprofloxacin, demonstrated improved antibacterial potency against E. faecalis. Recent developments, including chitosan-propolis nanoparticles, have demonstrated greater penetration into dentinal tubules and better antibiofilm efficacy against E. faecalis biofilms [3].

Notwithstanding the increasing data endorsing the antibacterial efficacy of propolis, significant diversity is observed among studies concerning extraction techniques, formulations, concentrations, and research approaches. A thorough assessment of the existing evidence is essential to ascertain the efficacy of propolis as an intracanal medicament against Enterococcus faecalis. This systematic review is to critically evaluate and synthesise the existing research on the role of propolis in endodontic disinfection and to compare its antibacterial efficiency with that of traditional intracanal medicaments.

Material and Methods:

Protocol and Registration

This systematic review was performed in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review sought to assess the antibacterial effectiveness of propolis against Enterococcus faecalis when utilised as an intracanal medicament in endodontic treatment.

Research Question

The focused research question was formulated according to the PICO framework:

- **Population (P):** Root canals infected with *Enterococcus faecalis*
- **Intervention (I):** Propolis used as an intracanal medicament
- **Comparison (C):** Conventional intracanal medicaments such as calcium hydroxide, chlorhexidine, sodium hypochlorite, triple antibiotic paste, or saline
- **Outcome (O):** Reduction or elimination of *Enterococcus faecalis* measured through colony-forming units (CFUs), minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC), biofilm reduction, or antibacterial efficacy

The review question was: *"Is propolis effective against Enterococcus faecalis as an intracanal medicament compared with conventional endodontic medicaments?"*

Eligibility Criteria

Inclusion Criteria

Studies that met the following criteria were included:
1. Studies conducted in vitro, ex vivo, or clinically assessing propolis as an intracanal medicament.
2. Research evaluating antibiotic effectiveness against Enterococcus faecalis.
3. Research contrasting propolis with alternative intracanal medicaments, like calcium hydroxide, chlorhexidine, or antibiotic pastes.
4. Articles published in English.
5. Full-text articles accessible from 2006 to 2026.

Exclusion Criteria

The subsequent studies were omitted:
1. Evaluate review papers, case reports, editorials, and conference abstracts.
2. Research excluding Enterococcus faecalis.
3. Research assessing propolis for purposes beyond intracanal treatment.
4. Redundant publications or unfinished investigations.
5. Research devoid of sufficient methodological specifics or outcome data.

Information Sources and Search Strategy

A comprehensive electronic literature search was conducted using PubMed, Scopus, Google Scholar, Web of Science, and ScienceDirect databases. The search was carried out for studies published from January 2006 to March 2026.

The search strategy included combinations of Medical Subject Headings (MeSH) terms and keywords such as “propolis,” “Enterococcus faecalis,” “intracanal medicament,” “root canal disinfection,” “endodontics,” “calcium hydroxide,” and “chlorhexidine.” Boolean operators “AND” and “OR” were applied to optimize the search strategy. The primary search strategy used was: (“Propolis” AND “Enterococcus faecalis”) AND (“intracanal medicament” OR “root canal disinfection” OR “endodontics”). In addition, manual searching of the reference lists of selected articles was carried out to identify additional studies relevant to the review topic.

Study Selection

All collected publications were imported into reference management software, and duplicate studies were eliminated. Two independent evaluators examined the titles and abstracts of all identified studies. The complete texts of possibly pertinent articles were subsequently evaluated based on the inclusion and exclusion criteria. Discrepancies among reviewers were reconciled through dialogue and consensus.

Data Extraction

The reviewers independently conducted data extraction via a standardised form. The information gathered from each study encompassed the author's name, year of publication, study design, sample size, type and concentration of propolis utilised, comparison groups, duration of medicament application, microbial assessment methodologies, and principal findings concerning antimicrobial efficacy against E. faecalis. This review primarily evaluated the antibacterial efficacy of propolis through the reduction of bacterial count, inhibition of bacterial growth, or disruption of biofilm formation.

Quality Assessment & Data Synthesis

The reviewers independently evaluated the methodological quality and risk of bias of the included research, considering study design, sample preparation, microbiological standardisation, control group utilisation, and result reproducibility. Owing to the heterogeneity present in the included studies concerning methodology, propolis concentration, outcome measures, and comparison groups, a qualitative synthesis of the data was conducted rather than a quantitative meta-analysis. The results of all included trials were systematically synthesised and analysed to assess the efficacy of propolis as a potential intracanal medicament against Enterococcus faecalis.

Results:

A total of 35 records were identified through database searching, with an additional 5 records identified through other sources. After removal of 5 duplicates, 30 records remained for screening.

Following title and abstract screening, 16 records were excluded due to irrelevance, review articles, case reports, or insufficient data. 14 full-text articles were assessed for eligibility. Of these, one study was excluded due to lack of relevant outcome measures.

Finally, **13 studies were included** in the qualitative synthesis.

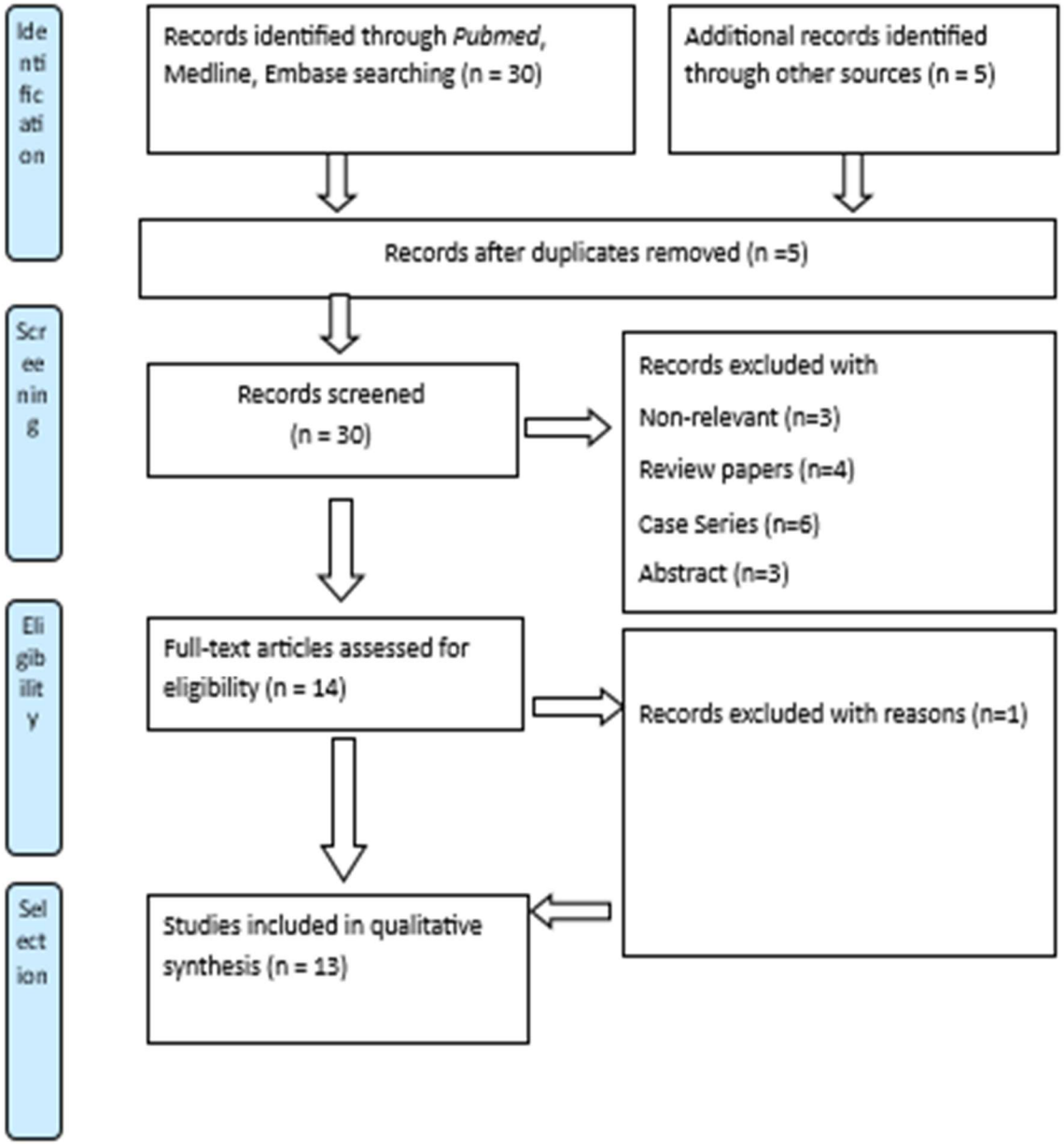
Identification
Screening
Eligibility
Selection
Records identified through Pubmed, Medline, Embase searching (n = 30)
Additional records identified through other sources (n = 5)
Records after duplicates removed (n =5)
Records screened (n = 30)
Records excluded with
Non-relevant (n=3)
Review papers (n=4)
Case Series (n=6)
Abstract (n=3)
Full-text articles assessed for eligibility (n = 14)
Records excluded with reasons (n=1)
Studies included in qualitative synthesis (n = 13)

Figure 1: PRISMA flow chart

Table 1: Characteristics and Main Outcomes of Included Studies Evaluating Propolis against *Enterococcus faecalis*

Author/Year	Study Design	Sample Characteristics	Propolis Formulation & Concentration	Comparison Group(s)	Evaluation Method	Main Findings	Conclusion
Oncag et al., 2006 [7]	In vitro study	180 extracted single-rooted human teeth infected with *E. faecalis*	Propolis extract	Calcium hydroxide, chlorhexidine, other medicaments	Microbiological sampling at 48 h and 10 days	Propolis showed strong antibacterial activity against *E. faecalis* at both 48 hours and 10 days.	Propolis can be used as an alternative intracanal medicament.
Madhubala et al., 2011 [10]	In vitro study	120 extracted human permanent incisors contaminated with *E. faecalis*	Ethanol extract of propolis	Calcium hydroxide, triantibiotic mixture, saline	Percentage reduction in colony counts (%RCC) at days 1, 2, and 7	Propolis showed 100% reduction in colony count by day 2. Triantibiotic mixture showed 82.5%, 92.2%, and 98.4% reduction on days 1, 2, and 7, respectively. Calcium hydroxide showed maximum 59.4% reduction on day 7.	Propolis was highly effective against *E. faecalis* and comparable to triantibiotic mixture.
Zare Jahromi et al., 2012 [1]	In vitro study	80 human single-rooted teeth incubated with *E. faecalis*	Propolis intracanal medicament	Calcium hydroxide and ethanol	Colony-forming unit (CFU) count and MIC evaluation	MIC and CFU values of propolis were significantly lower than calcium hydroxide.	Propolis exhibited superior antibacterial efficacy against *E. faecalis*.
Ahangari et al., 2012 [11]	In vitro experimental study	42 extracted single-rooted human teeth	30% propolis extract	Calcium hydroxide	Colony count after 72 h, 1 week, and 1 month	Mean colony counts after 72 h were 55,000±46,368 for propolis and 43,333±48,027 for calcium hydroxide. No colonies observed after 1 month in either group.	Propolis may serve as a natural alternative intracanal medicament.

Pimenta et al., 2015 [12]	In vitro study	30 bovine dentin discs infected with *E. faecalis*	20% and 40% brown propolis paste	Calcium hydroxide, Carbowax control	Spectrophotometric microbial growth analysis	40% propolis paste showed 35.8% antibacterial activity; combination with calcium hydroxide showed 41% activity, compared with 21.3% for calcium hydroxide alone.	Brown propolis demonstrated effective antibacterial capacity.
Shrivastava et al., 2015 [9]	Laboratory in vitro study	Standard bacterial culture model	Propolis alone and in combination with ciprofloxacin and moxifloxacin	Calcium hydroxide and antibiotic groups	Zone of inhibition measurement at 24, 48, and 72 h	Mean zone of inhibition was highest with propolis + moxifloxacin (21.94±4.26 mm), followed by propolis alone (18.71±4.26 mm), while calcium hydroxide showed lowest activity (12.89±2.14 mm).	Propolis alone and in combination enhanced antibacterial action against *E. faecalis*.
Wahjuningrum et al., 2017 [13]	In vitro study	Glass surface bacterial adherence model	Propolis extract (8–16 µg/mL)	Untreated control	Bacterial adherence and biofilm assessment	Propolis at 14 µg/mL showed maximum inhibition of bacterial adherence and biofilm formation.	Propolis may help prevent biofilm-mediated endodontic infections.
Parolia et al., 2020 [3]	In vitro biofilm study	240 extracted human teeth infected with *E. faecalis* biofilm	Chitosan-propolis nanoparticles (100 and 250 µg/mL)	Calcium hydroxide, chlorhexidine, saline	CFU count, SEM, CLSM analysis	CPN250 showed greatest CFU reduction at 200 µm and 400 µm dentinal depth on days 1, 3, and 7.	Nanoparticle-based propolis demonstrated enhanced antibiofilm efficacy.
Elsayed et al., 2021 [5]	In vitro study	108 extracted single-rooted teeth contaminated with *E. faecalis*	Propolis alone and combined with $Ca(OH)_2$ and CHX	Calcium hydroxide, chlorhexidine, control	Colony count after 2, 7, and 10 days	Propolis and propolis + calcium hydroxide groups demonstrated effective reduction in *E. faecalis* colonies over 2, 7, and 10 days.	Propolis showed promising antibacterial activity as intracanal medicament.

Rosli et al., 2023 [14]	In vitro antimicrobial study	Laboratory culture of *E. faecalis*	Malaysian propolis extract	Calcium hydroxide, chlorhexidine, ethanol	MIC and MBC evaluation	MIC values: chlorhexidine <0.008%, propolis 0.03%, calcium hydroxide 0.62%. MBC values: propolis 0.07%, calcium hydroxide 1.25%.	Malaysian propolis was more effective than calcium hydroxide.
Refaay et al., 2025 [15]	In vitro study	30 extracted primary anterior teeth infected with *E. faecalis*	11% aqueous propolis extract	-	Pre- and post-irrigation bacterial colony count	Propolis reduced *E. faecalis* count by 61.8%,	Propolis possesses significant antimicrobial activity against *E. faecalis*.
Almahameed et al., 2025 [16]	Randomized controlled in vitro study	20 extracted premolars contaminated with *E. faecalis*	Calcium hydroxide + propolis paste	Calcium hydroxide + saline paste	Bacterial colony count at different time intervals	Mean bacterial count at T2 was 0.030 in propolis group versus 0.363 in saline group.	Addition of propolis improved antibacterial efficacy of intracanal paste.
Quintana-Pérez et al., 2026 [6]	In vitro intratubular study	Dentinal tubule infection model with *E. faecalis*	Chihuahuan propolis extract (15, 35, and 70 mg/mL)	Triple antibiotic paste	MIC, CFU reduction, SEM analysis	Propolis at 70 mg/mL achieved CFU reduction comparable to triple antibiotic paste after 7 days. MIC of propolis was 17.5 mg/mL.	Propolis may serve as a potential non-antibiotic intracanal medicament.

Table 1 indicated that the included research primarily comprised in vitro investigations assessing the antibacterial activity of propolis against Enterococcus faecalis. Various formulations of propolis, including ethanolic extracts, aqueous extracts, brown propolis, and nanoparticle-based preparations, were juxtaposed with traditional intracanal medicaments such as calcium hydroxide, chlorhexidine, sodium hypochlorite, and antibiotic pastes.

Numerous investigations have shown statistically significant antibacterial efficacy of propolis against E. faecalis. Zare Jahromi and colleagues [1]. Demonstrated markedly reduced colony-forming units and minimum inhibitory concentration values for propolis in comparison to calcium hydroxide ($p<0.001$). Madhubala et al. [10] showed a complete bacterial decrease with propolis by day two, demonstrating greater efficiency than calcium hydroxide. Refaay et al. [15] demonstrated a 61.8% reduction in E. faecalis count using aqueous propolis extract ($p<0.001$), whereas Almahameed et al. [16]. demonstrated markedly reduced bacterial counts in the propolis-containing paste group in comparison to the calcium hydroxide-saline paste ($p=0.042$). Parolia et al. [3] similarly discovered that chitosan-propolis nanoparticles markedly diminished biofilm bacteria in comparison to control groups ($p<0.05$).

The data suggest that propolis demonstrates significant antibacterial and antibiofilm properties against Enterococcus faecalis, with multiple trials indicating efficacy equal to or above that of calcium hydroxide. Nevertheless,

discrepancies in research methodologies and propolis formulations underscore the necessity for additional standardised studies and clinical trials.

Figure 2. Risk of bias in included studies *a)* Traffic-light plot of risk of bias for each individual study. *b)* Summary plot showing the proportion of studies at low, unclear, or high risk of bias across domains.

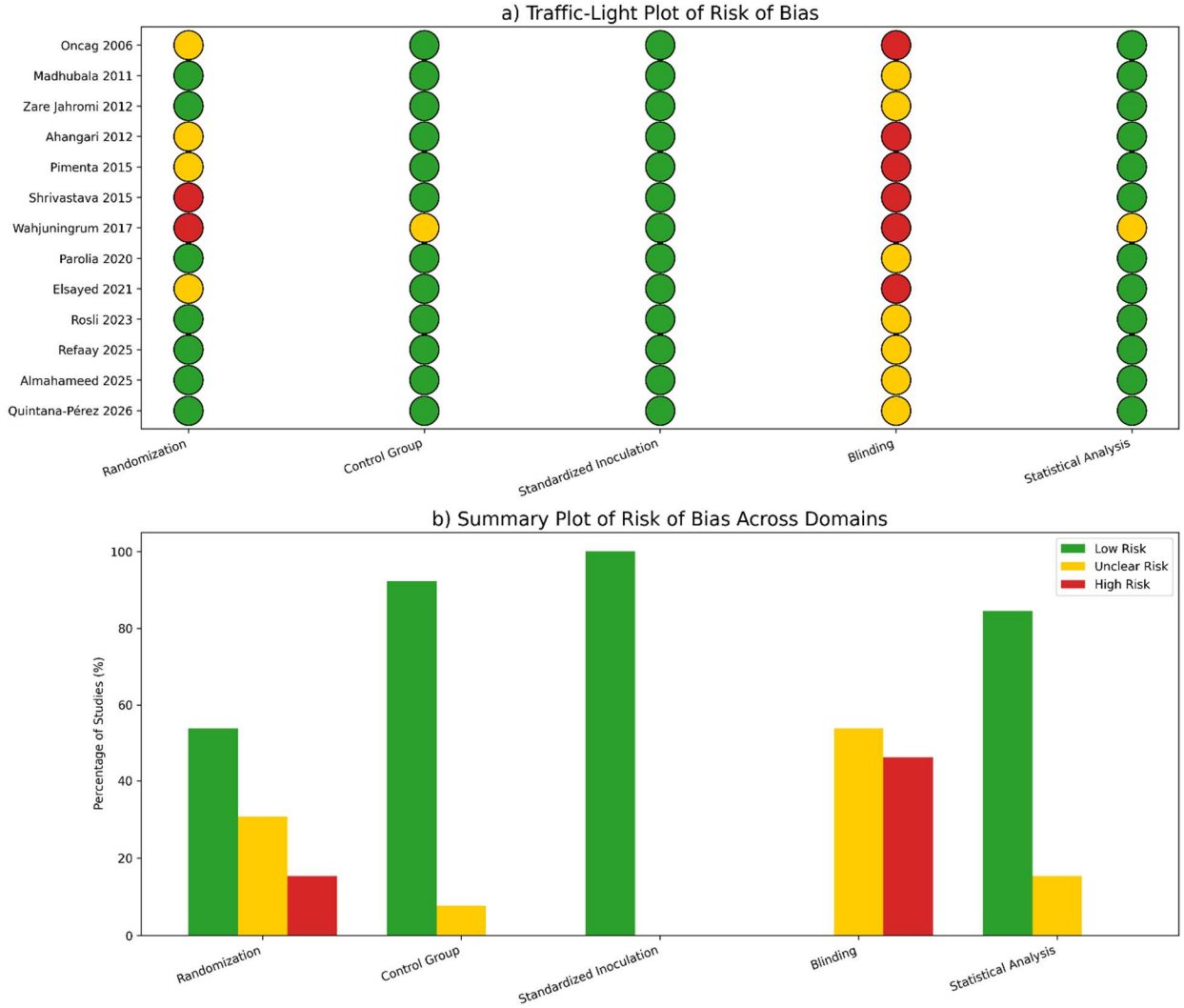

Figure (a) displays the traffic-light map that assesses the likelihood of bias for each included study across many methodological domains, such as randomisation, control group selection, standardised microbiological inoculation, blinding, and statistical analysis. The majority of research exhibited a minimal risk of bias due to the utilisation of suitable control groups, standardised inoculation methods, and rigorous statistical analysis. Nevertheless, numerous research indicated ambiguous or elevated risk of bias in the areas of randomisation and blinding, attributable to inadequate reporting of allocation procedures and absence of assessor blinding.

Figure (b) delineates the aggregate distribution of research classified as low, unclear, or high risk of bias across all assessed categories. Standardised microbial inoculation demonstrated the best methodological quality, with all studies categorised as having a minimal risk of bias. Control groups were adequately recorded in 92.3% of studies, although statistical analysis indicated a low risk in 84.6% of studies. Conversely, blinding constituted the most deficient methodological category, with 53.8% of studies exhibiting an unclear risk and 46.2% demonstrating a significant risk of bias. Randomisation techniques were sufficiently documented in just 53.8% of trials, whereas 30.8% and 15.4% exhibited ambiguous and high risk of bias, respectively.

Discussion

The efficacy of endodontic treatment is fundamentally reliant on the thorough eradication of germs from the root canal system. The intricate anatomy of root canals and the capacity of bacteria to infiltrate dentinal tubules render thorough disinfection challenging to accomplish. Enterococcus faecalis is considered one of the most resilient microorganisms linked to persistent endodontic infections due to its capacity to endure harsh environmental conditions, withstand alkaline pH, build biofilms, and penetrate dentinal tubules [2-3]. Consequently, the pursuit of alternative intracanal medicaments exhibiting enhanced antibacterial efficiency and biocompatibility has garnered significant interest in recent years.

The results of this systematic study demonstrate that propolis possesses considerable antibacterial efficacy against E. faecalis and may function as a viable natural intracanal medicament. The majority of the included research indicated that propolis was either equivalent to or more effective than calcium hydroxide in diminishing bacterial proliferation and biofilm development. Calcium hydroxide has historically been regarded as the benchmark intracanal medicament due to its elevated alkalinity and antibacterial characteristics. Nonetheless, other research featured in this review validated the restricted efficacy of calcium hydroxide against E. faecalis, presumably attributable to the buffering capacity of dentin and the organism's resilience to alkaline conditions [1,10].

Zare Jahromi and colleagues [1]. Demonstrated markedly reduced colony-forming units (CFUs) and minimum inhibitory concentration (MIC) values for propolis in comparison to calcium hydroxide ($p<0.001$), signifying enhanced antibacterial effectiveness. Madhubala et al. [10] noted a full reduction of germs with propolis within two days, but calcium hydroxide exhibited only modest antibacterial effects. The data indicate that propolis may demonstrate a more expedited antibacterial effect against resistant endodontic infections.

The antibacterial efficacy of propolis is primarily ascribed to its abundant constituents of flavonoids, phenolic acids, aromatic compounds, and esters. These bioactive compounds are recognised for their ability to damage bacterial cell walls, decrease enzymatic function, interfere with protein synthesis, and diminish bacterial adhesion and biofilm formation [6]. Wahjuningrum et al. [13] revealed that propolis markedly diminished the adhesion of E. faecalis to surfaces, consequently limiting biofilm formation. Given that biofilm production is a significant virulence factor in chronic endodontic infections, the antibiofilm properties of propolis offer a crucial therapeutic benefit.

Numerous trials featured in the study also assessed the efficacy of propolis in conjunction with other antimicrobial treatments. Shrivastava et al. [9] showed that the combination of propolis and moxifloxacin yielded the largest zone of inhibition against E. faecalis, indicating a synergistic antibacterial activity. Similarly, Almahameed et al. [16] discovered that calcium hydroxide in conjunction with propolis exhibited markedly reduced bacterial counts in comparison to calcium hydroxide paired with saline ($p=0.042$). The data suggest that propolis may improve the effectiveness of standard intracanal medicaments when utilised in combination therapy.

Recent advancements in nanotechnology have enhanced the prospective clinical applications of propolis. Parolia et al. [3] found that chitosan-propolis nanoparticles shown substantial antibacterial and antibiofilm efficacy, achieving more penetration into dentinal tubules than traditional medicaments. Nanoparticle formulations enhance surface area, penetration capacity, and prolonged release of bioactive chemicals, therefore augmenting antibacterial efficacy. Quintana-Pérez et al. [6] also showed that elevated concentrations of Chihuahuan propolis attained antibacterial activity comparable to that of triple antibiotic paste. These findings indicate that novel propolis formulations may serve as effective non-antibiotic alternatives for intracanal disinfection.

While most of the included studies exhibited positive outcomes, certain limitations must be acknowledged. The majority of studies in this review were in vitro examinations, which may not fully emulate the clinical conditions of the root canal system. Significant variability was noted among studies concerning propolis source, extraction techniques, concentration, duration of application, and methods of result assessment. Furthermore, there is a paucity of knowledge concerning the long-term clinical efficacy, cytotoxicity, and standardisation of propolis formulations at present. The bias risk assessment indicated ambiguous or elevated risk in specific areas, including blinding and randomisation, especially in older trials.

Notwithstanding these constraints, the cumulative evidence indicates that propolis has significant antibacterial efficacy against Enterococcus faecalis. Its natural origin, biocompatibility, antibiofilm properties, and capacity to augment standard medications render it a promising intracanal medicament in endodontics. Nevertheless, additional standardised in vitro research, animal studies, and rigorously structured randomised clinical trials are essential to determine appropriate formulations, concentrations, and clinical protocols for the routine application of propolis in endodontic therapy.

Conclusion

Propolis had notable antibacterial efficacy against Enterococcus faecalis and indicated considerable promise as an intracanal medicament in endodontic treatment, despite the constraints of the included investigations. Numerous investigations indicated that propolis demonstrated antibacterial efficiency equivalent to or exceeding that of calcium hydroxide, along with additional benefits including antibiofilm activity, biocompatibility, and natural origin. Diverse formulations of propolis, such as ethanolic extracts, aqueous extracts, and nanoparticle-based preparations, significantly diminished bacterial populations and impeded biofilm formation in the root canal system.

Moreover, the amalgamation of propolis with standard intracanal medicaments and antibiotics exhibited augmented antibacterial properties, indicating potential synergistic advantages. Propolis formulations utilising nanotechnology demonstrated enhanced penetration into dentinal tubules and superior antibacterial effectiveness against resistant E. faecalis biofilms.

The trials considered exhibited methodological variation in terms of propolis formulation, concentration, length of administration, and outcome assessment techniques. The majority of current evidence is confined to in vitro investigations, with scant clinical evidence present. Consequently, additional rigorously designed randomised clinical trials and standardised experimental studies are essential to determine the optimal concentration, formulation, safety, and long-term clinical efficacy of propolis prior to its endorsement as a routine intracanal medicament in clinical endodontic practice.

References

1. Zare Jahromi M, Toubayani H, Rezaei M. Propolis: A new alternative for root canal disinfection. Iran Endod J. 2012; 7(3): 127-133.
2. Karlak V, Ortarzewska M, Jankowski J, Nijakowski K. Propolis efficiency against *Enterococcus faecalis* compared with other intracanal medicaments: a systematic review with meta-analysis. J Stoma. 2024; 77(2): 136-146.
3. Parolia A, Kumar H, Ramamurthy S, Davamani F, Pau A. Effectiveness of chitosan-propolis nanoparticle against *Enterococcus faecalis* biofilms in the root canal. BMC Oral Health. 2020; 20: 339.
4. Madhubala MM, Srinivasan N, Ahamed S. Comparative evaluation of propolis and triantibiotic mixture as an intracanal medicament against *Enterococcus faecalis*. J Endod. 2011; 37(9): 1287-1289.
5. Elsayed RO, Yagoub SO, Abubakr NH. Evaluation of propolis as intracanal medicament against *Enterococcus faecalis*. Open J Stomatol. 2021; 11: 208-220.
6. Quintana-Pérez HN, Orozco-Molina GG, Villegas-Mercado CE, Santana-Delgado SA, Gonzalez-Acosta A, Martínez-Hernández JI, et al. Chihuahuan propolis as a non-antibiotic intracanal agent against Enterococcus faecalis: An in vitro intratubular study. Microorganisms. 2026; 14(4): 774.
7. Oncag O, Cogulu D, Uzel A, Sorkun K. Efficacy of propolis as an intracanal medicament against *Enterococcus faecalis*. Gen Dent. 2006; 54(5): 319-322.
8. Ahangari Z, Eslami G, Ghannad S. In vitro antimicrobial activity of propolis in comparison with calcium hydroxide against *Enterococcus faecalis*. J Dent Sch. 2012; 30(1): 9-17.
9. Shrivastava R, Rai VK, Kumar A, Tripathi P, Gupta K. An in vitro comparison of endodontic medicaments propolis and calcium hydroxide alone and in combination with ciprofloxacin and moxifloxacin against *Enterococcus faecalis*. J Contemp Dent Pract. 2015; 16(5): 394-399.

10. Madhubala MM, Srinivasan N, Ahamed S. Comparative evaluation of propolis and triantibiotic mixture as an intracanal medicament against *Enterococcus faecalis*. J Endod. 2011; 37(9): 1287-1289.
11. Ahangari Z, Eslami G, Ghannad S. In vitro antimicrobial activity of propolis in comparison with calcium hydroxide against *Enterococcus faecalis*. J Dent Sch. 2012; 30(1): 9-17.
12. Pimenta HC, Violante IMP, de Musis CR, Borges ÁH, Aranha AMF. In vitro effectiveness of Brazilian brown propolis against *Enterococcus faecalis*. Braz Oral Res. 2015; 29(1): 1-6.
13. Wahjuningrum DA, Subijanto A. Influence of extract propolis on the adherence of enterococcus faecalis as a candidate root canal irrigation solution. International Journal of Sceince and Clinical Laboratory 2015; 8 :1-1.
14. Rosli N, Che Elliaziz NA, Al-Bayaty FH, Ismail IH. The antimicrobial properties of Malaysian propolis as intracanal medicament in endodontics. J Dentists. 2023; 11: 16-22.
15. Refaay M, Almonakel MB, Alsalameh S, Hawary I, Alsayed Tolibah Y. The effectiveness of aqueous propolis extract in reducing the *Enterococcus faecalis* count in primary teeth: An in vitro study. Int J Dent. 2025; 2025: 7629615.
16. Almahameed A, Kassis J, Aboud M, Layous K. Evaluation of antibacterial efficacy of propolis as an intercanal medicament against Enterococcus faecalis (a randomized controlled in vitro study). Heliyon. 2025; 11: e41733.