

REVIEW

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Probiotics as an adjunctive therapy in periodontal diseases: a systematic review.

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Abstract

Introduction. Periodontitis is a chronic inflammatory disease driven by a dysbiotic oral microbiome and an altered host immune response, leading to progressive destruction of the periodontal supporting tissue. Although non-surgical periodontal therapy remains the cornerstone of treatment, residual inflammation and microbial recolonization are frequently observed. In recent years, probiotics have emerged as a potential adjunctive approach aimed at modulating the oral microbiome and host response. **Aim of the study.** The aim of this study was to evaluate the effectiveness of probiotics as an adjunct to non-surgical periodontal therapy in improving clinical and microbiological outcomes in patients with periodontal diseases. **Methods.** A systematic search was conducted in PubMed for RCTs published between 2020 and 2025 investigating probiotics as adjuvant therapy in patients with gingivitis or chronic periodontitis. Inclusion criteria: human studies, clinical outcomes measured (PD, CAL, BOP, PI), and follow-up ≥ 4 weeks. Fifteen relevant studies were selected for detailed analysis. **Results.** The analyzed studies have shown that adjunctive probiotic therapy resulted in additional improvements in periodontal clinical parameters, particularly probing pocket depth reduction, clinical attachment gain, and decreased bleeding indices, compared to conventional therapy alone. Beneficial shifts in the periodontal microbiota were also reported. **Conclusions.** Probiotics appear to be a promising adjunctive strategy in the non-surgical management of periodontal diseases. While current evidence supports their beneficial clinical effects, standardized protocols and long-term studies are required before definitive clinical recommendations can be established.

Keywords: Probiotics, Non-surgical periodontal therapy, Oral microbiome, Scaling and root planing, Adjunctive treatment, Oral health.

Introduction

Periodontal diseases are chronic inflammatory conditions affecting the supporting structure of the teeth and represent a significant Global Health burden. Periodontitis, the advanced form of periodontal disease is characterized by progressive destruction of the periodontal ligament and alveolar bone, potentially leading to tooth loss if untreated [1]. Despite improvements in preventive and therapeutic strategies the prevalence of the periodontitis remains high worldwide, emphasizing the need for more effective and biologically oriented adjunctive therapies [2].

Current understanding of periodontal pathogenesis has shifted from a pathogen-centered model toward a dysbiosis-driven concept. Rather than being caused by specific microorganisms alone, periodontitis results from an imbalance in the oral microbiome combined with dysregulated host immune-inflammatory response [2]. This dysbiotic Biofilms triggers a sustained inflammatory

cascade that drives connective tissue breakdown and bone resorption, highlighting the importance of therapeutic strategies targeting both microbial and host-related factors [2, 3]. Non-surgical periodontal therapy, primarily scaling and root planing (SRP), remains the cornerstone of periodontal treatment.

Mechanical debridement effectively reduces bacterial load and inflammation, however, complete elimination of periodontal pathogens is rarely achieved. [4] Residual periodontal pockets, rapid recolonization of the pathogenic bacteria and persistent inflammation are frequently observed following conventional therapy, which may compromise long-term treatment outcomes [4, 5].

To enhance the effectiveness of non-surgical therapy, various adjunctive approaches have been proposed, including systemic and locally delivered anti-microbials resistance, adverse effects, and disruption of the commensal oral microbiota [5]. These

limitations have stimulated interest in alternative therapeutic strategies that aim to restore microbial balance rather than indiscriminately suppress bacterial populations [6].

In this context, probiotics have emerged as a promising adjunctive approach in periodontal therapy. Probiotics are defined as live microorganisms that, when administered in accurate amounts, confer a health benefit to the host [7]. In the oral environment, probiotics are thought to exert their effect through multiple mechanisms including competitive inhibition of periodontal pathogens, modulation of the host immune responses, enhancement of epithelial barrier integrity and production of antimicrobial substance [6].

Recent reviews have highlighted the growing interest in the application of probiotics in oral health, specifically in periodontal diseases [8]. These studies suggest that probiotics may contribute to the stabilization of the periodontal microbiome by reducing the abundance of pathogenic species and promoting beneficial microorganisms, thereby counteracting dysbiosis and limiting inflammatory tissue damage [8, 9]. Evidence from systematic reviews and meta-analyses focusing on human clinical studies indicates that the adjunctive use of probiotics in non-surgical periodontal therapy may lead to additional improvements in clinical outcomes compared to conventional therapy alone [10]. Reported benefits include reductions in probing pocket depth, gains in clinical attachment level, and decreases in bleeding indices. [9] Moreover, microbiological analyses have shown favorable shifts in subgingival microbial profiles following probiotic supplementation, supporting their role in microbiome modulation rather than pathogen eradication [11].

Despite encouraging findings, the current body of evidence is marked by considerable heterogeneity. Differences in probiotic strains dosage, delivery systems, duration of administration and follow-up limit the comparability of the studies [12]. Furthermore, variations in study design and patient

characteristics complicate the interpretation of results and preclude definitive clinical recommendations [10,11].

Emerging evidence also suggests that probiotics may influence periodontal health through additional biological pathways beyond microbial modulation [13].

Immunomodulatory and antioxidant effects have been proposed, indicating that probiotics may attenuate inflammatory responses and oxidative stress, both of which play central roles in periodontal tissue destruction [14]. These mechanisms further support the potential role of probiotics as a biologically driven adjunctive therapy in periodontal care [10,12].

Given the increasing emphasis on minimally invasive and host modulating therapeutic strategies, probiotics represent a compelling adjunct in the management of periodontal diseases [15]. However, while short-term clinical benefits have been reported, long-term efficiency and optimal therapeutic protocols remain to be clearly established. Therefore, a comprehensive evaluation of recent human evidence is essential to clarify the role of probiotics in periodontal therapy and to guide their integration into clinical practice [14,15].

Material and methods

This review was conducted to evaluate recent evidence regarding the adjunctive use of probiotics in non-surgical periodontal therapy.

A literature search was performed using the PubMed database. Articles published predominantly between 2020 and 2025 were considered eligible. The search strategy included combinations of the following keywords: Periodontitis, Periodontal disease, probiotics, oral microbiome, non-surgical periodontal therapy, and scaling root planning.

Only studies published in English and conducted on human subjects were included. The applied filters restricted the result to randomized controlled trials, systematic reviews, meta-analyses, and narrative reviews

with clinical relevance. animal studies in vitro investigations, case reports, conference abstracts and studies lacking clinical periodontal outcomes were excluded.

The primary clinical outcomes assessed across the included studies were probing depth (PPD), clinical attachment level (CAL), and bleeding indices. Secondary outcomes included microbiological changes in the subgingival

biofilm following probiotic administration. Relevant data were extracted regarding study design, sample size, probiotic strains, mode and duration of administration, and follow up period. Due to heterogeneity in study designs and outcome measures, results were qualitatively synthesized without performing a quantitative meta-analysis.

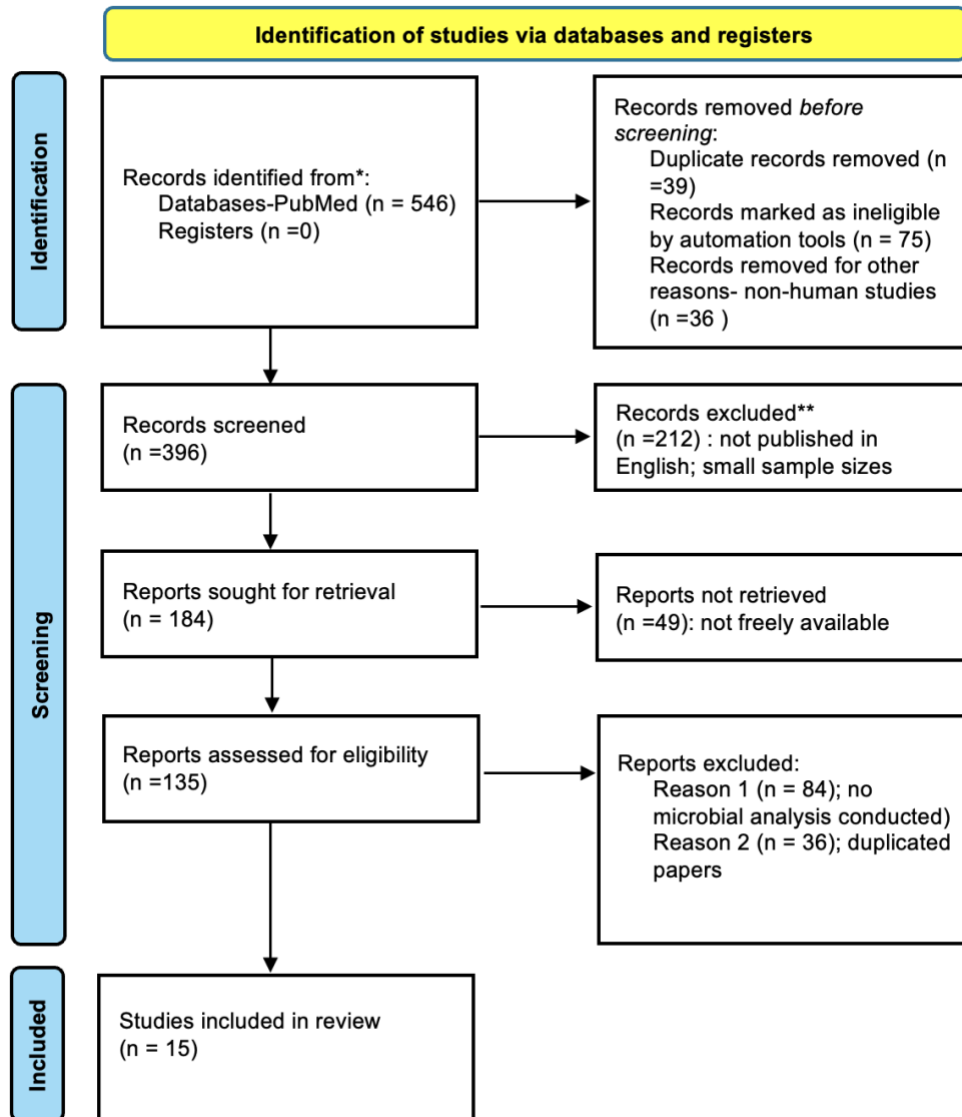


Figure 1. Flow diagram summarizing study selection and inclusion process [10]

Results

The results of the present research are presented in Table 1.

Table 1. Main outcomes of the included studies.

Author	Year	Study Type	Sample / Focus	Main Pathogenic Link	Main Findings / Outcomes	Key Conclusions
Sedgui LM et al. [1]	2021	Review	Overview of periodontal disease pathogenesis	Dysbiotic biofilm and host immune response.	Integrates established and novel concepts of periodontal pathogenesis including influences like oral probiotics.	Complex dysbiosis-host interactions justify exploration of adjunctive microbiome -modulating therapies.
Rad AH et al. [2]	2023	Review	Probiotics and postbiotics in oral health	Oral microbial dysbiosis and inflammation.	Summarizes evidence on probiotic and possibility effects on oral microbiota and inflammatory control.	Probiotics/postbiotics may support periodontal health, but standardized clinical evidence is still limited.
Baddouri L et al. [3]	2024	Narrative Review	Clinical studies on probiotics as adjunctive therapy in periodontitis	Periodontitis related to microbial dysbiosis and inflammation.	Reviewed ~40 clinical studies; mixed results do study heterogeneity; some improved outcomes in severe cases.	Probiotics may improve outcomes when used as adjuncts, but cautious interpretation is needed.
Duarte de Mendonça C. et al. [4]	2024	Systematic review & network meta-analysis	33 RCTs (1290 patient) comparing PMRP + placebo	Periodontal tissue destruction associated with plaque- induced inflammation.	Significant mean improvements in PPD, CAL and BOP with several probiotic interventions; Lactobacillus showed the strongest effects.	Combining PMRP with probiotics is more effective than PMRP alone for improving PPD and CAL; Lactobacillus appears most effective.
Karaca B et al. [5]	2022	Narrative review	Oxidative stress, probiotics in periodontitis	Oxidative stress-driven periodontal tissue damage.	Highlights Nrf2 activations as a mechanism to counteract oxidative stress; probiotics may enhance antioxidant response.	Probiotics/postbiotics may support periodontal health via Nrf2 pathway activation.
Furlaneto F, et al. [6]	2022	Narrative Review	Probiotics are adjuncts in periodontal therapy	Subgingival microbiota recolonization and exaggerated host response.	Reviews evidence that probiotics interfere with periodontal pathogens, modulate host immune response and support epithelial barrier integrity.	Probiotics represent a promising adjunct for controlling inflammation and supporting periodontal stability.
Ng E et al. [7]	2022	Systematic review and meta-analysis	RCTs Evaluating probiotics adjuncts to non-surgical periodontal therapy.	Persistent inflammation and microbial dysbiosis after SRP.	Meta-analysis shows additional improvements in PPD and CAL with adjunctive probiotics compared to SRP alone.	Adjunctive probiotic therapy provides measurable clinical benefits in periodontitis.
Villafuerte KRV et al. [8]	2021	Systematic review	Microbiological effects of adjunctive probiotics in periodontal therapy.	Subgingival microbial dysbiosis associated with periodontitis.	Reports reduction in periodonto- pathogenic bacteria and favorable microbiological shifts With adjunctive probiotic use.	Probiotics may contribute to periodontal therapy by modulating subgingival microbiota.
Farias da Cruz M et al. [9]	2022	Bibliometric and critical review	RCTs Evaluating probiotics (including dairy	Cytokine imbalance and immune activation	Elevated salivary IL-17 and IL-18 levels correlated with	The shared Cytokine network links intestinal and

			products) in oral parameters in humans.		periodontal inflammation.	periodontal inflammation.
Şahin T [10]	2022	Randomized control clinical trial.	36 periodontitis patients receiving IPT with probiotics, kefir, or no supplements.	Dysbiotic subgingival microbiota associated with periodontal inflammation.	Significant intragroup improvements in periodontal indices; <i>Tannarella forsythia</i> levels significantly decrease in all groups.	Kefir administered adjunctively to IPT provides clinical outcomes to probiotics.
Poulose M et al. [11]	2022	Randomized controlled clinical trial	62 periodontitis patients treated with SRP ± subgingival probiotic application.	Subgingival pathogenic biofilm and periodontal inflammation.	Greater clinical improvements in PPD and other periodontal parameters in the probiotic ± group; probiotic bacteria remained viable up to 8 days.	Subgingival probiotics provide sustained clinical benefits when used adjunctively with SRP.
Patyna M et al. [12]	2021	Randomized control clinical pilot study	48 patients with periodontitis treated with SD ± LAD ± probiotics.	Subgingival pathogenic biofilm and inflammation.	All groups improved PPD and CAL; SD+ LAD + probiotics showed greater reductions in BOP, gingival index and red complex bacteria (<i>P. gingivalis</i> , <i>T. forsythia</i>).	Adding probiotics to SD + LAD improves inflammatory and microbiological parameters compared to SD alone.
Yilmaz FÇ et al. [13]	2025	Randomized clinical trial	120 female periodontitis patients treated with conventional therapy ± probiotics ± anti-inflammatory diet.	Subgingival microbial dysbiosis and host inflammatory response leading to periodontal tissue breakdown.	Significant reductions in PD and CAL, greatest in probiotic + diet group.	Probiotics enhance clinical outcomes, with additional benefit from an anti-inflammatory diet.
Furlaneto F et al. [14]	2024	Randomized clinical trial	60 generalized gingivitis patients receiving conventional therapy + placebo vs probiotic lozenges.	Supragingival microbial dysbiosis driving gingival inflammation and bleeding.	Probiotic group had greater reduction in BOMP at 8 weeks vs placebo; probiotic altered sub/supragingival microbial profile.	Adjunct <i>B. Lactis</i> HN019 enhances bleeding reduction and promotes favorable microbiological changes.
Doucette H et al. [15]	2024	Scoping review	19 studies on pre/probiotics as adjuncts in periodontal disease.	Microbial dysbiosis and immune-inflammatory dysregulation driving periodontal tissue destruction.	Most studies reported positive effects of probiotics on periodontal parameters.	Pre/probiotics show promising adjunctive benefits; further research needed dosage, strains and delivery methods.

Discussions

The findings summarized in this review support the growing interest in probiotics as an adjunctive strategy in the non-surgical management of periodontal diseases [1]. Contemporary periodontal therapy increasingly recognizes that mechanical debridement alone may be insufficient to fully restore periodontal health, specifically in the presence of dysbiotic microbiome and persistent inflammatory response [2]. This conceptual shift from pathogen eradication to microbiome modulation provides a strong

biological rationale for the use of probiotics in dental care [2, 3].

Several randomized controlled trials and high-level evidence syntheses included in this review suggest that adjunctive probiotic therapy may enhance clinical outcomes when combined with scaling and root planing [4]. Improvements in key periodontal parameters have been consistently reported, indicating that probiotics may contribute to improved periodontal stability beyond that achieved with conventional therapy alone [5]. These effects appear to be particularly relevant in reducing

residual information, which is a common limitation of non-surgical periodontal treatment [5, 6].

The mechanisms underlying the beneficial effects of probiotics in periodontal therapy are multi-factorial. One proposed mechanism involves competitive inhibition, whereby probiotic strains limit in adhesion and proliferation of periodontal pathogenic bacteria within the subgingival biofilm [7].

Additionally, probiotics may alter the local microbial ecosystem by promoting beneficial commensal species, thereby counteracting dysbiosis rather than indiscriminately suppressing bacterial populations. This ecological approach aligns with current understanding of periodontal diseases pathogenesis [8].

Beyond microbial interactions, probiotics may exert immunomodulatory effects that influence periodontal inflammation, emerging evidence suggests that probiotic supplementation can modulate host immune responses, potentially reducing the production of pro-inflammatory mediators associated with periodontal tissue destruction, such host modulating properties are particularly relevant even that periodontal breakdown is largely driven by an exaggerated inflammatory response rather than direct bacterial damage alone [9, 10].

Despite these promising observations, considerable heterogeneity exists among included studies. variations in probiotic strains, dosage regimens, modes of administration and duration of treatment limit the ability to draw definitive conclusions regarding optimal clinical protocols [11].

Furthermore, differences in patient populations, disease severity, and follow up. Complicate direct comparison between studies. This heterogeneity represents a major limitation within the current body of evidence [12]

Another important consideration is the mode of probiotic delivery. Studies have investigated systemic administration through lozenges or capsules as well as local subgingival application. While both approaches appear to offer

potential benefits, it remains unclear which method provides superior clinical outcomes or sustained microbiological effects [13].

Local delivery may offer targeted action within periodontal pockets, whereas systemic administration may exert broader immunological effects. Further comparative studies are needed to clarify these differences [14].

The duration of probiotic administration and long-term sustainability of clinical benefits also warrant careful consideration. Most available studies focus on the short term follow up periods, the meeting conclusion regarding long-term periodontal stability and disease recurrence. [15]. Given the chronic nature of periodontal diseases, long-term studies are essential to determine whether probiotic associated benefits are maintained over time or require repeated administration [12].

In addition, some studies have extended probiotic search beyond periodontitis to include gingival inflammation, suggesting potential benefits across the periodontal disease spectrum [14]. These findings raise the possibility that it may play a role not only in treatment but also in the prevention of early intervention. However, extrapolation between gingivitis and periodontitis should be performed cautiously due to differences in disease pathophysiology and tissue involvement [15].

Overall, the current evidence supports the adjunctive use of probiotics as a promising and biologically driven approach in periodontal therapy [13]. However, methodological limitations, study heterogeneity, and the lack of standardized treatment protocols prevent definitive clinical recommendations [13]. Future research should focus on well-designed randomized controlled trials with standardized probiotic formulations, clearly defined outcomes and extended follow-up periods to clarify the true clinical value of probiotics in periodontal care [14, 15].

Conclusions

Current evidence suggests that probiotics might serve as a beneficial adjunct to non-

surgical periodontal therapy by improving clinical outcomes and modulating the subgingival microbiome. Although short-term results are encouraging, heterogeneity among studies and limited long-term data prevent definitive clinical recommendations. Further well-designed, standardized clinical trials are required to clarify the optimal role of probiotics in periodontal care.

Author Contributions (CRediT Taxonomy)

Conceptualization: A-I.N.; A.V.; Data curation: A-I.N.; Methodology: A.V.; Project administration: A.V.; Software: A-I.N.; A.V.; Writing original draft: A-I.N.; A.V.; Supervision: A.V.; Writing review and editing: A.V.

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