Research Article

World J Curr Med Pharm Res. 2026; 8(1): 64-70

World Journal of Current Medical and Pharmaceutical Research

Content available at www.saap.org.in ISSN: 2582-0222

COMPARATIVE EVALUATION OF LACTOBACILLUS SALIVARIUS PROBIOTIC GEL AND CHLORHEXIDINE GEL AS AN ADJUNCT TO SCALING AND ROOT PLANING IN THE MANAGEMENT OF CHRONIC PERIODONTITIS: A RANDOMIZED CLINICAL STUDY

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ARTICLE HISTORY

Received on: 24-01-2026
Revised on: 17-02-2026
Accepted on: 08-04-2026

ABSTRACT

Aim: To evaluate and compare the efficacy of probiotic gel containing *Lactobacillus salivarius* and chlorhexidine gel as adjunct to scaling and root planing in patients with chronic periodontitis.

Materials and Methods: Group I (n = 24) received scaling and root planing (SRP) followed by local application of *Lactobacillus salivarius* probiotic gel, while Group II (n = 24) received SRP followed by chlorhexidine gel. Clinical parameters, including plaque index, sulcular bleeding index, probing pocket depth, and clinical attachment level, were recorded at baseline and after 3 months. Intragroup and intergroup comparisons were performed using appropriate statistical tests, with statistical significance set at $p < 0.05$.

Results: Intragroup comparison showed significant improvement in all clinical parameters at 3 months ($p < 0.05$). Intergroup comparison at 3 months showed significantly lower PPD and CAL in the probiotic group ($p < 0.05$), while PI and SBI were comparable ($p > 0.05$).

Conclusion: Probiotic gel containing *Lactobacillus salivarius* used as an adjunct to SRP demonstrated superior clinical improvement in probing pocket depth and clinical attachment levels compared to chlorhexidine gel.

Keywords: *Chronic periodontitis, Probiotics, Lactobacillus salivarius, Chlorhexidine gel, Scaling and root planning.*

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DOI: https://doi.org/10.37022/wjcmpr.v8i1.393

INTRODUCTION

Periodontal disease is the formation and accumulation of microbial biofilms on tooth surfaces, followed by a dysregulated host immune-inflammatory response that contributes to tissue destruction [1]. Complete elimination of periodontal pathogens through scaling and root planning (SRP) alone is often challenging, particularly in residual periodontal pockets [2]. Consequently, adjunctive antimicrobial agents have been employed to prevent recolonization [3].

Local drug delivery of adjunctive chemotherapeutic agents are often employed to improve clinical outcomes Chlorhexidine is widely regarded as an effective antimicrobial agent in periodontal therapy [4]. However, its long-term use is associated with several adverse effects, including tooth staining, altered taste sensation, and mucosal irritation, which may limit patient compliance [5]. Local delivery of probiotics helps to restore a healthy microbial balance by suppressing oral dysbiosis and promoting the growth of beneficial symbiotic microorganisms. *Lactobacillus salivarius* has the potential to alter the subgingival microbial composition by suppressing gram-negative periodontal pathogens and promoting the colonization of beneficial gram-positive microorganisms. This probiotic strain can inhibit pathogenic bacteria through the production of antimicrobial substances including bacteriocins, hydrogen peroxide, and organic acids, as well as by competing with pathogens for adhesion sites and

nutrients within the oral biofilm [6,7]. Studies have demonstrated that *Lactobacillus salivarius* supplementation can decrease periodontal pathogens levels with decreased gingival inflammation and plaque accumulation when used as an adjunct to SRP [8, 9]. In addition, probiotics may help regulate host immune responses by reducing pro-inflammatory cytokines and promoting a balanced oral microbiota, thereby contributing to periodontal health [10]. *Lactobacillus salivarius* has demonstrated antimicrobial, immunomodulatory effects and can be used as a promising adjunct in periodontal therapy, although research evaluating its clinical effectiveness remains limited. Hence, the present study was aimed to comparatiely access the clinical efficacy of *Lactobacillus salivarius* gel and chlorhexidine gel as adjuncts to SRP in patients with chronic periodontitis.

MATERIALS AND METHODS

Source of data and study design

Patients diagnosed with chronic periodontitis were selected for the study. Ethical approval for this study was obtained from the Institutional Ethical Committee of SIBAR Institute of Dental Sciences (Reference No: 554/IEC/SIBAR/2025). Written informed consent was obtained from all participants prior to their inclusion in the study. The clinical trial was registered with the Clinical Trials Registry (Registration No. CTRI/2025/09/0947000) and was conducted in accordance with the ethical standards of the Declaration of Helsinki (1975, revised 2013).

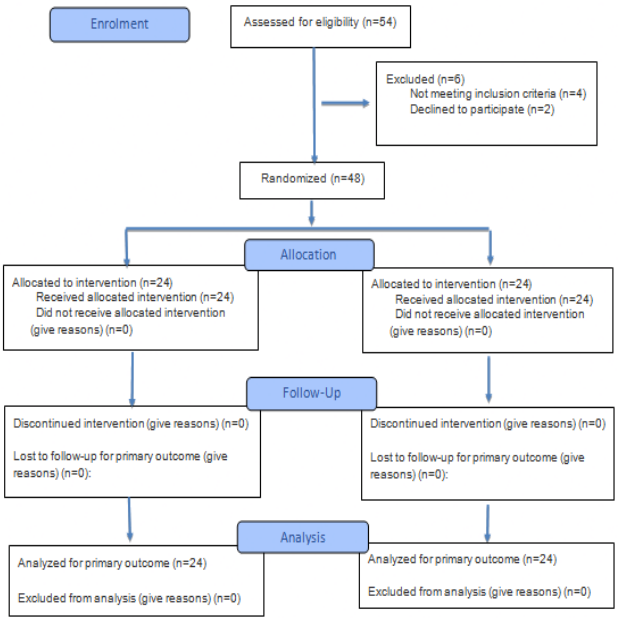

Figure 01: shows the CONSORT flow diagram.

Sample Size

Sample size was calculated using G*Power software version 3.1.9.4 with an effect size of 0.83, an alpha error of 0.05, and a power (1–β) of 0.80. A total sample size of 48 patients was obtained. To compensate for potential dropouts, 54 patients were recruited.

Inclusion and Exclusion Criteria

Participants aged 30–55 years with residual periodontal pockets ≤5 mm and bleeding on probing, who had not received periodontal therapy in the previous 3 months and were systemically healthy, were included in the study. Exclusion criteria included the presence of systemic diseases, pregnancy or lactation, tobacco use, a history of drug allergy or recent medication use, and periodontal therapy within the past 6 months.

Preparation of Probiotic Gel (2% w/v)

Carbopol 934 (1% w/w) was weighed and soaked overnight in Milli-Q water at 4 °C. A specified amount of probiotic powder (2% w/w) was added to the overnight-soaked Carbopol solution under magnetic stirring. Methyl paraben (0.18% w/w) and propyl paraben (0.02% w/w) were added to the dispersion as preservatives. The remaining water was added to make up the required weight. Finally, 1N NaOH solution was added dropwise until gel formation occurred. The prepared gel was stored in sterile airtight containers under refrigeration [11,12].

Clinical Procedure

Eligible participants underwent supragingival scaling at the initial visit. After one week, baseline clinical parameters, including Plaque Index (PI) [13], Probing Pocket Depth (PPD) [14], Clinical Attachment Level (CAL) [14], and Sulcular Bleeding Index (SBI) [15], were recorded, followed by subgingival scaling and root planing (SRP). Group I received SRP with Lactobacillus salivarius probiotic gel, while Group II received SRP with chlorhexidine gel. Participants maintained a self-reported diary to record tooth brushing and daily flossing frequency. Oral hygiene reinforcement was provided at 1-month intervals. Clinical parameters (PI, SBI, PPD, and CAL) were reassessed at the 3-month follow-up visit and compared with baseline values.

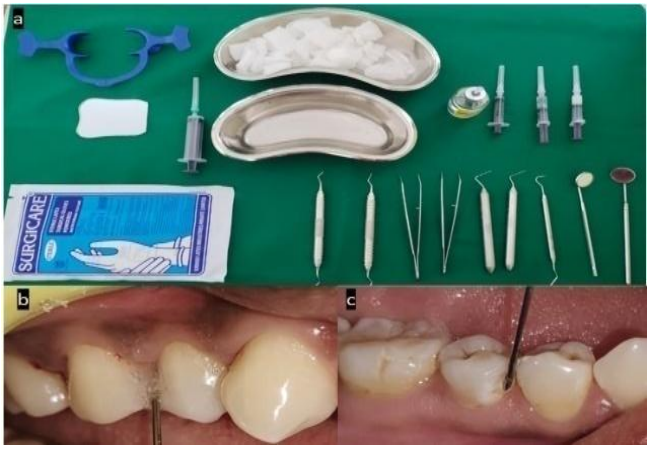

Figure 02: Local drug delivery of probiotic gel and chlorhexidine gel

a. Armamentarium b. Probiotic gel administration c. Chlorhexidine gel administration

Statistical Analysis

Data were analyzed by SPSS version using 20 software (IBM Corp., Armonk, NY, USA). Age between the two groups was compared using the independent sample t-test, while gender distribution was analyzed using the Chi-square test. Intragroup comparisons between baseline and 3 months were performed using the paired t-test, and intergroup comparisons wereanalyzed using the independent sample t-test. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 48 participants were included in the study and were randomly allocated into two groups: Probiotic gel group (n = 24) and Chlorhexidine gel group (n = 24). The mean age of participants in the probiotic group was 35.88 ± 0.85 years, whereas in the chlorhexidine group it was 36.13 ± 0.80 years. With respect to gender distribution, the probiotic group consisted of 12 males and 12 females, while the chlorhexidine group included 11 males and 13 females. No statistically significant difference in age, gender distribution between the groups ($p > 0.05$). Table 01 shows comparison of demographic Characteristics between probiotic gel and chlorhexidine gel Groups

The intragroup comparison of clinical parameters at baseline and 3 months is presented in Table 02. In the probiotic gel group, all clinical parameters showed a statistically significant reduction after 3 months of treatment ($p < 0.05$). The mean plaque index decreased from 2.84 ± 0.17 at baseline to 1.88 ± 0.26 at 3 months. Similarly, the sulcular bleeding index showed a marked reduction from 3.92 ± 0.82 to 1.38 ± 0.76. The mean probing pocket depth reduced from 4.88 ± 0.39 mm to 3.45 ± 0.30 mm, while the clinical attachment level improved from 4.89 ± 0.39 mm to 3.44 ± 0.31 mm.

Similarly, in the chlorhexidine gel group, all clinical parameters demonstrated statistically significant improvement at 3 months compared to baseline ($p < 0.05$). The mean plaque index reduced from 2.86 ± 0.17 to 2.08 ± 0.43, sulcular bleeding index from 3.54 ± 0.72 to 2.01 ± 0.56, probing pocket depth from 4.89 ± 0.33 mm to 4.60 ± 0.39 mm, and clinical attachment level from 4.86 ± 0.33 mm to 4.64 ± 0.39 mm.

The intergroup comparison of clinical parameters between the probiotic gel and chlorhexidine gel groups at baseline and 3 months is shown in Table 03. At baseline, there were no statistically significant differences between the two groups for any of the clinical parameters ($p > 0.05$), indicating comparability between the study groups.

At 3 months, the probiotic gel group demonstrated significantly greater improvement compared to the chlorhexidine gel group. The mean plaque index was 1.88 ± 0.26 in the probiotic gel group and 2.08 ± 0.43 in the chlorhexidine gel group, showing a statistically significant difference ($p < 0.05$). Similarly, the sulcular bleeding index was significantly lower in the probiotic gel group (1.38 ± 0.76) compared to the chlorhexidine gel group (2.01 ± 0.56) ($p < 0.05$). A highly significant reduction in probing pocket depth was observed in the probiotic gel group (3.45 ± 0.30 mm) compared with the chlorhexidine gel group (4.60 ± 0.39 mm) at 3 months ($p < 0.05$). Likewise, the probiotic gel group demonstrated greater improvement in clinical attachment level (3.44 ± 0.31 mm) compared to the chlorhexidine gel group (4.64 ± 0.39 mm) ($p < 0.05$).

The results of the present study demonstrated that the probiotic gel group showed greater improvement in clinical parameters such as plaque index, sulcus bleeding index, probing pocket depth, and clinical attachment level compared with the chlorhexidine gel group at 3 months.

Table 01: Comparison of demographic characteristics between probiotic gel and chlorhexidine gel groups

Variable	Probiotic Gel (n = 24)	Chlorhexidine Gel (n = 24)	Test value	p value*
Age (years)	35.88 ± 0.85	36.13 ± 0.80	t = -1.05	> 0.05
Gender			$\chi^2 = 0.00$	> 0.05
Male	12	11		
Female	12	13		

Descriptive statistics

A p-value* of <0.05 was considered statistically significant.

Table 02: Intragroup Comparison of Clinical Parameters at Baseline and 3 Months in the Groups

Groups	Parameter	Timeline	Mean	Std. Deviation	95% CI Lower	95% CI Upper	t value
Probiotic gel (N=24)	**PI**	Baseline	2.84	0.17	-0.13	1.69	-0.40
		3 Months	1.88	0.26			
	SBI	Baseline	3.92	0.82	2.32	2.75	24.46
		3 months	1.38	0.76			
	PPD (mm)	Baseline	4.88	0.39	1.29	1.55	21.48

		3 months	3.45	0.30				
	CAL (mm)	Baseline	4.89	0.39	-1.58	-1.30	-21.48	<0.05*
		3 months	3.44	0.31				
Chlorhexidine gel (N=24)	**PI**	Baseline	2.86	0.17	-0.95	-0.59	-8.73	<0.05*
		3 months	2.08	0.43				
	SBI	Baseline	3.54	0.72	-2.48	-1.76	-12.24	<0.05*
		3 months	2.01	0.56				
	PPD (mm)	Baseline	4.89	0.33	-0.63	-0.51	-19.44	<0.05*
		3 months	4.60	0.39				
	CAL (mm)	Baseline	4.86	0.33	-0.64	-0.51	-17.81	<0.05*
		3 months	4.64	0.39				

Paired t test

*P value** <0.05 statistically significant

Table 3: Intergroup comparison of clinical parameters between Probiotic and Chlorhexidgroups at baseline and 3 months

Parameter	Timeline	Groups	Mean	Std. Deviation	95% CI Lower	95% CI Upper	t value	p value*
PI	Baseline	Probiotic gel	2.84	0.17	-0.12	0.08	-0.41	>0.05
		Chlorhexidine gel	2.86	0.17				
	3 months	Probiotic gel	1.88	0.26	-0.36	-0.04	-2.51	<0.05*
		Chlorhexidine gel	2.08	0.43				
SBI	Baseline	Probiotic gel	3.92	0.82	-0.04	0.80	1.90	>0.05
		Chlorhexidine gel	3.54	0.72				
	3 months	Probiotic gel	1.38	0.76	-1.02	-0.24	-3.22	<0.05*
		Chlorhexidine gel	2.01	0.56				
PPD (mm)	Baseline	Probiotic gel	4.88	0.39	-0.20	0.16	-0.21	>0.05
		Chlorhexidine gel	4.89	0.33				
	3 months	Probiotic gel	3.45	0.30	-1.38	-0.92	-10.18	<0.05*
		Chlorhexidine gel	4.60	0.39				
CAL (mm)	Baseline	Probiotic gel	4.89	0.39	-0.17	0.21	0.21	>0.05
		Chlorhexidine gel	4.86	0.33				
	3 months	Probiotic gel	3.44	0.31	-1.38	-0.93	-10.07	<0.05*
		Chlorhexidine gel	4.64	0.39				

Independent Sample t-test

A *p*-value of < 0.05 was considered statistically significant.

DISCUSSION

The present randomized clinical trial evaluated and compared the adjunctive effects of Lactobacillus salivarius probiotic gel and chlorhexidine gel following scaling and root planing in patients with chronic periodontitis. Both treatment modalities resulted in significant improvements in all evaluated clinical parameters at the 3-month follow-up; however, the probiotic gel demonstrated superior reductions in probing pocket depth and clinical attachment loss when compared to chlorhexidine gel.

Scaling and root planing remains the gold standard in periodontal therapy, yet residual periodontal pockets frequently persist due to incomplete elimination of subgingival biofilms. This has led to the widespread use of adjunctive agents to enhance clinical outcomes. In the present study, significant reductions in plaque index were observed in both groups, corroborating findings by Quirynen et al [16], who reported improved plaque control when chemical agents were used as adjuncts to mechanical therapy.

Chlorhexidine is best antimicrobial agent with high substantivity within the mouth. Recent investigations have demonstrated the effectiveness of chlorhexidine gel when used as an adjunct to SRP which will align with present study. A randomized controlled clinical trial by Sanjay Gunjal et al. [17], evaluated the efficacy of chlorhexidine gel compared with Morus alba gel in patients with stage II periodontitis and reported significant reductions in plaque index, gingival index, and probing pocket depth following adjunctive application of chlorhexidine gel with SRP. Similarly, another randomized clinical trial by Hasan F, [18], assessing 1% chlorhexidine gel as a local drug delivery system demonstrated that subgingival placement of the gel within periodontal pockets resulted in significant improvements in gingival inflammation and periodontal clinical parameters. The above recent investigations have demonstrated the effectiveness of chlorhexidine gel when used as an adjunct to SRP which will align with present study.

The beneficial role of lactobacilli in periodontal health has been demonstrated in earlier investigations. Kõll-Klais et al. (2005) [19], reported that the presence of homofermentative lactobacilli, including L. salivarius, was inversely associated with clinical parameters of chronic periodontitis and the levels of periodontal pathogens, suggesting a protective ecological role of these organisms . In a subsequent study , Kõll et al . (2008) [20], characterized orally isolated lactobacilli and showed that most strains, including L. salivarius, inhibited the growth of major periodontopathogens such as Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, and Prevotella intermedia, indicating their potential as probiotic agents for periodontal health. These findings provide a microbiological basis for the pocket depth reduction observed in the probiotic gel group in the present study.

Clinical evidence further supports the periodontal benefits of L. salivarius. Shimauchi et al. (2008) demonstrated that oral administration of L. salivarius WB [21], significantly improved plaque index and probing depth compared with placebo, while Mayanagi et al. (2009) reported a significant reduction in the total load of periodontopathic bacteria, including Tannerella forsythia, following supplementation with L. salivarius WB [22]. These studies highlight microbial modulation as a key mechanism of probiotic action, which may explain the greater reduction in probing pocket depth and clinical attachment gain observed in the probiotic gel group in the present study.

Iwamoto et al. (2010) [23], further demonstrated that administration of L. salivarius WB21 reduced bleeding on probing and improved oral malodor, indicating a reduction in periodontal inflammation. In addition, Saïz et al. (2021) [24], in a systematic review on probiotics in oral health, reported that L. salivarius strains such as NK02 were associated with improvements in probing depth, gingival index, and bleeding on probing, along with a reduction in Aggregatibacter actinomycetemcomitans counts in chronic periodontitis patients. These observations are consistent with the significant reduction in sulcular bleeding index and probing pocket depth noted in the probiotic gel group in the present investigation.

Recent experimental evidence has also emphasized the ecological and biological plausibility of probiotics in periodontal therapy. Etebarian et al. (2023) [25], reported that L. salivarius and other lactobacilli can adhere to oral mucosa, exhibit antibacterial activity, and competitively inhibit periodontal pathogens, thereby facilitating colonization resistance and biofilm modulation. Such properties may contribute to sustained periodontal stability beyond the nonspecific antimicrobial effects of chlorhexidine.

Butera et al. (2020) [26], showed that probiotic-based toothpaste and chewing gum, when used as adjuncts to scaling and root planing (SRP), resulted in significant clinical improvements and selective reductions in orange-complex pathogens, particularly Prevotella intermedia and Fusobacterium nucleatum, supporting the role of probiotics as a valid adjunct to SRP. In agreement with this, Vishnusripriya et al. (2022) [27], reported that locally delivered probiotic paste combined with SRP produced greater reductions in gingival index, bleeding index, probing pocket depth, and gains in clinical attachment level compared with chlorhexidine gel. Additionally, Alahari et al. (2022) [28], in their systematic review and meta-analysis, observed that probiotic and chlorhexidine mouthwashes achieved comparable reductions in plaque and gingival indices, indicating similar efficacy in the management of plaque-induced gingivitis. These observations are consistent with the present study and suggest that probiotics may serve as a potential alternative to chlorhexidine-based products.

Nędzi-Góra et al. (2020) [29], evaluated L. salivarius SGL03 in patients with stage I and II periodontitis and reported a significant reduction in mean probing pocket depth despite minimal changes in plaque scores and bacterial counts, suggesting an immunomodulatory rather than purely antimicrobial mechanism of action. This aligns with the present findings, where significant pocket depth reduction and attachment gain were observed in the probiotic group without reliance on broad-spectrum antimicrobial activity.

The available evidence and the findings of the present study suggest that Lactobacillus salivarius probiotic gel is an effective adjunct to nonsurgical periodontal therapy. Its ability to modulate dysbiotic biofilm, inhibit key periodontal pathogens, and influence host immune-inflammatory responses may account for the superior reductions in probing pocket depth

and clinical attachment gain observed when compared with chlorhexidine gel. Considering the well-documented adverse effects associated with prolonged chlorhexidine use, probiotic therapy represents a biologically sound, patient-friendly, and promising alternative for long-term periodontal management.

Both probiotic gel and chlorhexidine gel, when used as adjuncts to scaling and root planing, were effective in improving periodontal clinical parameters over a 3-month period. However, the probiotic gel demonstrated superior improvement in probing pocket depth and clinical attachment level compared to chlorhexidine gel, suggesting a stronger therapeutic benefit in periodontal healing. Further long-term, multicenter clinical trials with larger sample sizes and microbiological analysis are required to better understand the mechanism of action of probiotic therapy and to establish its long-term effectiveness as an adjunct in periodontal treatment.

CONCLUSION

Probiotics help restore microbial balance within the oral cavity by promoting beneficial commensal bacteria and reducing dysbiosis associated with periodontal inflammation.Therefore, the adjunctive use of probiotic gel following scaling and root planing may provide a more biologically favorable approach for maintaining periodontal health by modulating the oral microbiome and reducing periodontal inflammation.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this manuscript.

FUNDING

This research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

AUTHOR CONTRIBUTION

Aishwarya Golapala: Data collection, analysis, and manuscript drafting. Deepa Anumala: Conceptualization, supervision, and critical revision of the manuscript. Sree Ramya Chennuru: Data interpretation and literature review. Padmini Raj Moturi: Methodology and validation. Satyasri Pothavarjula: Data curation and visualization. Kishore Kumar Katuri: Review, editing, and final approval of the manuscript.

INFORM CONSENT AND ETHICAL STATEMENT

Inform consent taken from the study participants and the present study is approved from the Sibar Institute of Dental Sciences (Reference No: 554/IEC/SIBAR/2025).

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to Dr. Ravindranath Dhulipalla, Professor and Head of the Department, Sibar Institute of Dental Sciences, for his invaluable guidance, constant support, and encouragement throughout the study.

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