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EMERGING ROLE OF PROBIOTICS IN MODULATING ORAL MICROBIOTA: A MICROBIOLOGICAL AND CLINICAL EVALUATION

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Abstract: Background: Dental caries remains a major oral health challenge worldwide, affecting individuals across different age groups despite advances in preventive dentistry. AIM: This study aimed to evaluate the emerging role of probiotics. **METHODOLOGY:** The present interventional clinical study was conducted in the Department of Microbiology, at a tertiary care center from January 2023. **RESULT**: Probiotic therapy for four weeks resulted in decrease in Plaque Index, Gingival Index, bleeding on probing, and salivary counts of Streptococcus mutans, Lactobacillus spp., and Candida albicans. But, the DMFT score remained unchanged during this duration of study. **CONCLUSION:** Probiotic administration effectively improved clinical parameters and significantly reduced cariogenic microbial load, showing its role in changing the oral microbiota. Thus, probiotics may serve as a safe and beneficial adjunct in the prevention and management of dental caries and gingivitis.

Keywords: probiotics, oral microbiota, clinical evaluation

INTRODUCTION

Dental caries remains a major oral health challenge worldwide, affecting individuals across different age groups despite advances in preventive dentistry. Rather than being caused by a single pathogen, caries develops as a consequence of ecological imbalance within the oral environment.1 The oral cavity harbors a highly diverse microbial community that exists in dynamic equilibrium with the host. When this balance is disturbed due to more carbohydrate intake, improper oral hygiene, or decreased salivary defense mechanisms, the microbial ecosystem transform

toward a more acidogenic population.2 This dysbiotic change favors the proliferation of cariogenic microorganisms . These bacteria have the ability to metabolize fermentable carbohydrates into organic acids and synthesize them into extracellular polysaccharides which enhancs the biofilm formation and bacterial adherence to tooth surfaces3. The sustained production of acids lowers the oral pH below the critical threshold that is required for enamel stability, initiating demineralization and that leads to cavitation. Therefore, dental caries is now a biofilm-mediated disease driven by microbial imbalance rather than simple bacterial presence alone.Conventional caries management primarily focuses on mechanical plaque removal, fluoride application, and restorative procedures when cavitation occurs. While fluoride plays an important role in enhancing remineralization and increasing enamel resistance to acid attack, it does not directly correct the underlying microbial changes that is responsible for disease initiation. Restorative interventions,

Is necessary in advanced cases, and are irreversible4. This has growing interest in preventive strategies that aim to restore microbial balance rather than Only suppress symptoms. In this context, probiotics have emerged as a promising biological approach for modulating the oral microbiota.Probiotics are live microorganisms that, when administered in adequate amounts, confer health benefits to the host. In the oral cavity, selected probiotic strains such as Lactobacillus and Bifidobacterium species exert beneficial effects through multiple mechanisms. These include competitive inhibition of pathogenic bacteria for adhesion sites, production of antimicrobial substances, modulation of local pH, and enhancement of host immune responses. By integrating into the oral biofilm, probiotics can suppress the growth and metabolic activity of cariogenic organisms, thereby reducing acid production and stabilizing the microbial ecosystem.5 The emerging role of probiotics extends beyond microbial reduction to observable clinical improvements. Any change of salivary microbial load has been associated with decrease in plaque accumulation, gingival inflammation, and bleeding on probing3. By decreasing levels of cariogenic bacteria such as S. mutans and other acidogenic species, probiotics may contribute to lowering caries risk and preventing progression of early lesions. Their ability to influence host inflammatory responses supports periodontal health, showing their dual microbiological and clinical relevance.Considering the present interventional clinical study that was designed to evaluate the emerging role of probiotics in modulating oral microbiota through both microbiological and clinical assessment.6 This study aims to provide comprehensive evidence regarding the effectiveness of probiotic therapy as a supportive strategy in maintaining oral health and preventing disease progression.

AIM

The aim of this study was to evaluate the emerging role of probiotics .

METHODOLOGY

The present interventional clinical study was conducted in the Department of Microbiology, SMS hospital. The study was carried out in year 2023-2024. Ethical clearance was obtained from the Institutional Ethics Committee prior to commencement of the study, and written informed consent was obtained from all participants. A total of 60 participants aged between 18 and 55 years with clinically diagnosed dental caries and/or gingivitis were included in the study. Participants were selected through simple random sampling from patients attending the outpatient department during the study period. Baseline clinical assessment included recording of Plaque Index (Silness and Löe), Gingival Index (Löe and Silness), Bleeding on Probing, and DMFT score. Unstimulated saliva samples (2–3 mL) were collected under aseptic conditions in sterile containers between ….. to avoid diurnal variation. Samples were transported immediately to the microbiology laboratory for processing.Saliva samples were subjected to routine microbiological culture by using selective culture media for isolation of oral microorganisms that include Streptococcus mutans, Lactobacillus species., and Candida albicans. These isolated colonies obtained after incubation were further identified and confirmed using the VITEK automated microbial identification system. Microbial load was expressed as colony-forming units (CFU/mL).

Participants were given a probiotic formulation containing Lactobacillus and Bifidobacterium species once daily for four weeks. They were directed to maintain routine oral hygiene practices and to avoid use of any antimicrobial mouthwash during the study period. Follow-up clinical and microbiological assessments were conducted at the end of four weeks using the same standardized procedures.

Participants aged 18–55 years with clinically diagnosed dental caries and/or mild to moderate gingivitis, who were willing to participate and provide written informed consent, were included in the study.Individuals who had received antibiotics, probiotic supplements, or antimicrobial mouthwashes within the past one month; patients with systemic illnesses such as diabetes mellitus or immunocompromised conditions; pregnant or lactating women; smokers and tobacco users; and individuals undergoing orthodontic treatment were excluded from the study.

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RESULT

Table 1: Demographic Characteristics of Study Participants (n = 60)

Age Group (years)	Number (n)	Percentage (%)
18–25	14	23.3%
26–35	18	30.0%
36–45	16	26.7%
46–55	12	20%

The majority of participants belonged to the 26–35 years age group (30.0%), followed by 36–45 years (26.7%) and 18–25 years (23.3%). The least representation was observed in the 46–55 years age group, comprising 20% of the total study population.

Table 2: Gender distribution

Gender	Number (n)	Percentage (%)
Male	26	43.3%
Female	34	56.7%

In our study, females constituted the majority of participants, accounting for 56.7% of the total sample. Males comprised 43.3% of the study population.

The baseline clinical assessment revealed a mean Plaque Index of 2.05 ± 0.40 and a Gingival Index of 1.85 ± 0.38, with bleeding on probing observed in 58% of participants. The mean DMFT score was 3.2 ± 1.1, indicating a moderate caries experience among the study population.

Table 3: Baseline and Post-Intervention Clinical Comparison (After 4 Weeks)

Parameter	Baseline (Mean ± SD)	4 Weeks (Mean ± SD)	P value
Plaque Index	2.05 ± 0.40	1.25 ± 0.30	0.0001**
Gingival Index	1.85 ± 0.38	1.05 ± 0.25	0.0001**
Bleeding on Probing (%)	58%	28%	NA
DMFT Score	3.2 ± 1.1	3.2 ± 1.1	1.000

After four weeks of probiotic therapy, the mean Plaque Index and Gingival Index showed a significant reduction of 0.80 units each, while bleeding on probing decreased from 58% to 28%. However, the DMFT score remained unchanged at 3.2 ± 1.1, indicating no short-term effect on established carious lesions.

Table 4: Baseline and Post-Intervention Microbiological Comparison

Microorganism	Baseline CFU/mL (Mean ± SD)	4 Weeks CFU/mL (Mean ± SD)	P value
Streptococcus mutans	$1.9 \times 10^5 \pm 0.3$	$0.9 \times 10^5 \pm 0.2$	0.0001**
Lactobacillus spp.	$1.3 \times 10^5 \pm 0.2$	$0.8 \times 10^5 \pm 0.1$	0.0001**
Candida albicans	$0.9 \times 10^4 \pm 0.1$	$0.3 \times 10^4 \pm 0.05$	0.0001**

Following four weeks of probiotic therapy, a significant reduction in salivary microbial counts was observed, with

Streptococcus mutans decreasing by 52.6%, Lactobacillus spp. by 38.4%, and Candida albicans by 66.6%.

Table 6: Distribution of Clinical Improvement After Probiotic Therapy

Degree of Improvement	Number (n)	Percentage (%)
Marked Improvement (>50% reduction in GI/PI)	32	53.3%
Moderate Improvement (25–50%)	20	33.3%
Mild/No Improvement (<25%)	8	13.4%

In our study, marked improvement was observed in 53.3% of participants, demonstrating more than 50% reduction in gingival and plaque indices. Moderate improvement was seen in 33.3%, while only 13.4% of participants showed mild or no improvement following probiotic therapy.

DISCUSSION

In our study, the majority of subjects belonged to the 26–35 years age group, forming 30.0% of the total sample, then followed by 36–45 years age group, which comprised 26.7% of the study population. Individuals aged 18–25 years represented 23.3% of the participants. The least number of subjects were observed in the 46–55 years age group, constituting 20% of the total sample.

In our study, a total of 60 participants were included for evaluation. Among them, 34 participants were females, accounting for 56.7% of the total study population. Male participants were 26, representing 43.3% of the sample. Thus, females slightly outnumbered males in the present study. The gender distribution shows a modest female predominance. Starck E et al7 with 57.5% females and 42.5% males. Most participants were of African ethnicity (77.5%), and groups were comparable across sociodemographic and behavioural variables.

In our study, the baseline clinical evaluation showed a mean Plaque Index (PI) of 2.05 ± 0.40, that indicates a moderate plaque accumulation among the study participants. The mean Gingival Index (GI) was recorded as 1.85 ± 0.38, indicating mild to moderate gingival inflammation.

58% of the study population have bleeding on probing, suggesting considerable gingival involvement . The mean DMFT score seen was 3.2 ± 1.1. These findings showed the existing conditions of plaque, gingiva, and caries among the participants prior to probiotic intervention. Babina et al8 in their study showed a significant decrease in gingival bleeding at the post-intervention time.

In our study, a significant improvement in clinical parameters was observed after four weeks of probiotic therapy.The mean Plaque Index reduced from 2.05 ± 0.40 to 1.25 ± 0.30, a reduction of 0.80 units. Similarly, the Gingival Index reduced from 1.85 ± 0.38 to 1.05 ± 0.25, with a mean difference of 0.80. Bleeding on probing also showed a reduction from 58% to 28%. However, the DMFT score remained unchanged at 3.2 ± 1.1 after the probiotic therapy. This suggests that while probiotic therapy effectively reduced plaque accumulation and gingival inflammation, it did not change existing carious lesions that is present within the short study duration.SImilarly Santana et al.9 (2022) in their study explored a multispecies probiotic's impact on edentulous patients with peri-implant mucositis, revealing reduced bleeding on probing and inflammation. Laleman et al10. (2019) in their study reported that probiotic lozenges significantly reduced pocket depth in patients with periodontitis.

In our study, a significant reduction in salivary microbial load was observed after four weeks of probiotic therapy. The mean count of Streptococcus mutans decreased from $1.9 \times 10^5 \pm 0.3$ CFU/mL at baseline to $0.9 \times 10^5 \pm 0.2$ CFU/mL, showing a reduction of 52.6%. Similarly, Lactobacillus spp. counts declined from $1.3 \times 10^5 \pm 0.2$ CFU/mL to $0.8 \times 10^5 \pm 0.1$ CFU/mL, representing a 38.4% decrease. A marked reduction was also noted in Candida albicans, with counts falling from $0.9 \times 10^4 \pm 0.1$ CFU/mL to $0.3 \times 10^4 \pm 0.05$ CFU/mL, amounting to a 66.6% reduction. These findings demonstrate a substantial decrease in cariogenic and opportunistic microorganisms following probiotic administration.

In our study, total of 32 participants (53.3%) showed greater than 50% reduction in Plaque Index and Gingival Index scores. Moderate improvement, defined as a 25–50% reduction, and was observed in 20 participants (33.3%). Only 8 participants (13.4%) have mild or no improvement after the intervention period. These findings indicate that the majority of subjects responded positively to probiotic administration. Kang et al.11 (2020) found that probiotics improved periodontal health in adults, with reduced bleeding and altered oral bacteria levels.Lee et al.12 (2021) conducted a double-blind study indicating that oral probiotic tablets might contribute to reducing halitosis and improving quality of life related to oral health

CONCLUSION

The present clinical study showed that probiotic intake for 4 weeks resulted in marked improvement in both clinical and microbiological parameters. A marked decrease in Plaque , Gingival Index, and bleeding on probing was seen, indicating improved gingival health and reduced inflammatory response. The DMFT score remained unchanged during the short duration of study .Mainly, a decrease in salivary counts of Streptococcus mutans, Lactobacillus spp., and Candida albicans confirmed effective changes in the oral microbiota.

More than half of the participants showed marked clinical improvement, supporting the therapeutic potential of probiotics as an adjunct in caries and gingivitis management.

The reduction in cariogenic and opportunistic microorganisms identified through culture and VITEK confirmation, highlights the ecological benefits of probiotic therapy in restoring microbial balance. The findings in our study suggest that probiotics serve as a safe, non-invasive adjunctive strategy for improving oral health through microbiological and clinical modulation.

BIBLIOGRAPHY

1. Kassebaum NJ, Bernabé E, Dahiya M, et al. Global burden of untreated caries: A systematic review and metaregression. J Dent Res 2015;94(5):650–658. DOI: 10.1177/0022034515573272.
2. Takahashi N, Nyvad B. The role of bacteria in the caries process: Ecological perspectives. J Dent Res 2011;90(3):294–303. DOI: 10.1177/0022034510379602.
3. Petersen PE. The World Oral Health Report 2003: Continuous improvement of oral health in the 21st century–the approach of the WHO Global Oral Health Programme. Community Dent Oral Epidemiol 2003;31(Suppl 1):3–23. DOI: 10.1046/j.2003.com122.x.
4. Marinho VC, Worthington HV, Walsh T, et al. Fluoride varnishes for preventing dental caries in children and adolescents. Cochrane Database Syst Rev 2013;2013(7):CD002279. DOI: 10.1002/14651858.CD002279.pub2.
5. Twetman S, Stecksén-Blicks C. Probiotics and oral health effects in children. Int J Paediatr Dent 2008;18(1):3–10. DOI: 10.1111/j.1365-263X.2007.00885.x.
6. Hill C, Guarner F, Reid G, et al. Expert consensus document. The International Scientific Association for Probiotics and Prebiotics consensus statement on the scope and appropriate use of the term probiotic. Nat Rev Gastroenterol Hepatol 2014;11(8):506–514. DOI: 10.1038/nrgastro.2014.66.
7. Starck E, Machado V, Botelho J, Proença L, Barroso H, Ascenso C, Rozan C. Effects of Probiotic Short-Term Regiment on Oral Health Parameters in Children: A Pilot Randomized Controlled Trial. Nutrients. 2025 Nov 18;17(22):3604. doi: 10.3390/nu17223604. PMID: 41305654; PMCID: PMC12655477.
8. Babina, K., Salikhova, D., Doroshina, V., Makeeva, I., Zaytsev, A., Uvarichev, M., Polyakova, M., & Novozhilova, N. (2023). Antigingivitis and Antiplaque Effects of Oral Probiotic Containing the Streptococcus salivarius M18 Strain: A Randomized Clinical Trial. Nutrients, 15(18), 3882. https://doi.org/10.3390/nu15183882
9. Santana S.I., Silva P.H.F., Salvador S.L., Casarin R.C.V., Furlaneto F.A.C., Messora M.R. Adjuvant Use of Multispecies Probiotic in the Treatment of Peri-Implant Mucositis: A Randomized Controlled Trial. J. Clin. Periodontol. 2022;49:828–839. doi: 1111/jcpe.13663. [DOI] [PubMed] [Google Scholar]
10. 10.Laleman I., Pauwels M., Quirynen M., Teughels W. The Usage of a Lactobacilli Probiotic in the Non-Surgical Therapy of Peri-Implantitis: A Randomized Pilot Study. Clin. Oral. Implants Res. 2020;31:84–92. doi: 10.1111/clr.13555. [DOI] [PubMed] [Google Scholar]
11. Effects of Probiotic Bacterium Weissella Cibaria CMU on Periodontal Health and Microbiota: A Randomised, Double-Blind, Placebo-Controlled Trial - PubMed. [(accessed on 12 July 2023)]; doi: 10.1186/s12903-020-01231-2. Available online: https://pubmed.ncbi.nlm.nih.gov/32878603/ [DOI] [PMC free article] [PubMed]
12. Lee D.-S., Kim M., Nam S.-H., Kang M.-S., Lee S.-A. Effects of Oral Probiotics on Subjective Halitosis, Oral Health, and Psychosocial Health of College Students: A Randomized, Double-Blind, Placebo-Controlled Study. Int. J. Environ. Res. Public Health. 2021;18:1143. doi: 10.3390/ijerph18031143. [DOI] [PMC free article] [PubMed] [Google Scholar]