



**Role of Probiotics in Improving Oral Microbiome Stability
Among Young Adults**

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Abstract

The oral microbiome plays a central role in maintaining oral health, influencing processes such as caries development, periodontal disease progression, and overall oral immunity. In recent years, probiotics have emerged as a promising biological intervention for stabilizing the dysbiotic oral microbiome, particularly among young adults who commonly exhibit lifestyle-related fluctuations in oral microbial profiles. This study aims to explore the effects of probiotic supplementation on oral microbiome stability, salivary pH, plaque accumulation, and pathogenic bacterial load in individuals aged 18–30 years.

The research incorporates an observational and interventional approach, combining microbial culture analysis, salivary biomarker evaluation, and structured dietary/probiotic intake questionnaires. Young adults frequently face oral microbiome imbalance due to stress, irregular diet patterns, increased sugar consumption, smoking, and inconsistent oral hygiene routines. Probiotics—especially strains like *Lactobacillus rhamnosus*, *Lactobacillus reuteri*, *Bifidobacterium lactis*, and *Streptococcus salivarius* K12—have demonstrated the potential to reduce pathogenic bacteria such as *Streptococcus mutans* and *Porphyromonas gingivalis* while enhancing colonization of beneficial organisms.

This study evaluates a 30-day probiotic intervention and assesses microbiome stability using salivary tests, microbial quantification methods, and pH measurements. The findings indicate a notable improvement in oral ecological balance, with enhanced salivary buffering capacity, reduced plaque index scores, and a visible reduction in halitosis-associated bacterial strains.



Participants also reported subjective improvements in oral freshness, gum comfort, and reduced sensitivity.

The results support the hypothesis that probiotics can act as a noninvasive, accessible, and cost-effective adjunctive therapy for maintaining oral microbial equilibrium, especially in young adults with lifestyle-driven dysbiosis. The study concludes that consistent probiotic intake may help reduce the risk of caries, gingivitis, and opportunistic infections, establishing probiotics as a valuable preventive strategy in modern dentistry.

Keywords: Probiotics, Oral microbiome, Young adults, Salivary biomarkers, Dysbiosis, Lactobacillus, Oral health, Microbial stability, Streptococcus mutans, Probiotic therapy, Salivary pH, Plaque index.

Introduction

The oral cavity is one of the most complex microbial ecosystems in the human body, harboring more than 700 bacterial species that interact continuously with host tissues, diet, saliva, and lifestyle factors. In young adults, oral microbiome stability is essential for preventing dental caries, periodontal diseases, halitosis, enamel demineralization, and inflammatory responses. However, modern habits such as frequent snacking, increased consumption of processed foods, stress, smoking, alcohol intake, and irregular oral hygiene practices significantly disrupt this microbial balance, creating a shift toward dysbiosis.

Dysbiosis is characterized by the overgrowth of pathogenic species like *Streptococcus mutans*, *Prevotella intermedia*, and *Fusobacterium nucleatum*, combined with a reduction in protective commensal bacteria. Traditional approaches for managing oral diseases include fluoride therapy, antiseptic mouthrinses, mechanical plaque control, and periodontal treatment. While effective, these methods do not directly address microbial equilibrium, and in some cases, strong antiseptics may disrupt beneficial bacteria alongside harmful ones.



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Probiotics have emerged as a targeted biological solution offering a more natural approach to microbial restoration. Defined as “live microorganisms that provide health benefits when administered in adequate amounts,” probiotics have been widely used in gastrointestinal health but are now gaining prominence in dentistry. Probiotic strains like *Lactobacillus reuteri*, *Streptococcus salivarius* K12, *Bifidobacterium lactis*, and *Lactobacillus paracasei* have shown the ability to inhibit pathogenic bacteria through competitive exclusion, production of antimicrobial substances, and modulation of host immune responses.

Among young adults, probiotics may play a particularly impactful role in restoring oral microbiome stability due to this age group’s dynamic lifestyle patterns. The present study investigates the effectiveness of probiotics in improving oral microbial balance, enhancing salivary defenses, and reducing harmful bacterial counts. By analyzing salivary biomarkers, dietary behaviors, and clinical parameters, this research provides comprehensive insight into the preventive benefits of probiotics in modern dental care.

Methodology

This study followed a mixed-method research design combining clinical examination, laboratory testing, and questionnaire-based analysis to assess the impact of probiotics on oral microbiome stability among young adults aged 18–30 years. A total sample of **120 participants** was selected using stratified random sampling to ensure representation across different dietary habits, oral hygiene practices, and lifestyle patterns. Participants were divided into two groups: **Group A (Probiotic Intervention Group)** and **Group B (Control Group)**, each consisting of 60 individuals.

Prior to the intervention, all participants underwent baseline clinical assessments, including plaque index scoring, gingival index evaluation, salivary flow rate measurement, pH assessment, and microbial culture analysis. Saliva samples were collected in sterile containers following a 2-hour fasting period to



ensure consistency. Microbial profiling was performed using standard culture techniques alongside polymerase chain reaction (PCR)–based identification for key bacterial strains such as *Streptococcus mutans*, *Porphyromonas gingivalis*, *Fusobacterium nucleatum*, and *Streptococcus salivarius*.

Group A was administered a **daily probiotic supplement** containing *Lactobacillus reuteri* (1×10^8 CFU), *Streptococcus salivarius* K12 (1×10^9 CFU), and *Bifidobacterium lactis* (1×10^8 CFU). Participants consumed one chewable probiotic tablet every morning for **30 consecutive days**. In contrast, Group B received no probiotic supplementation and continued their standard oral hygiene practices. Both groups were instructed to avoid additional antimicrobial mouthrinses to prevent confounding variables.

A structured questionnaire collected data on dietary habits, sugar consumption, frequency of brushing, stress levels, smoking/alcohol intake, and self-reported oral health changes. Follow-up assessments were conducted on Day 15 and Day 30. Saliva samples were recollected to monitor microbiome changes, pH variations, salivary buffering capacity, and total bacterial load. Statistical analysis included paired t-tests, ANOVA, and correlation coefficients to evaluate the differences between and within both groups. Ethical approval was obtained from an institutional review board, and informed consent was secured from all participants.

5. Data

The collected data focused on clinical parameters, salivary biomarkers, and microbial profiling before and after probiotic intervention. Baseline results showed that both groups exhibited signs of mild dysbiosis, with elevated levels of *Streptococcus mutans* and reduced beneficial bacterial populations such as *Streptococcus salivarius*. Salivary pH levels averaged between 6.1–6.4, indicating a slightly acidic environment conducive to enamel demineralization. After 30 days, Group A demonstrated significant improvements in multiple oral health indicators. Salivary pH increased to an average of 6.9–7.1, reflecting

enhanced buffering capacity, whereas Group B showed negligible change. Microbial load analysis revealed a 40–55% reduction in harmful bacterial strains in the probiotic group, while commensal strains increased by 25–30%. Plaque index scores also reduced more prominently in Group A (0.6 average reduction) compared to Group B (0.2 average reduction).

Below are the key data tables:

Table 1: Salivary pH Comparison

Day	Group A (Probiotics)	Group B (Control)
Baseline	6.2	6.3
Day 15	6.7	6.3
Day 30	7.0	6.4

Table 2: Streptococcus mutans Count (CFU/mL)

Day	Group A	Group B
Baseline	5.4×10^5	5.2×10^5
Day 15	3.1×10^5	5.0×10^5
Day 30	2.4×10^5	5.1×10^5

Table 3: Plaque Index Scores

Day	Group A	Group B
Baseline	1.8	1.7
Day 15	1.3	1.6
Day 30	1.2	1.5

These data sets indicate clear improvements in the probiotic group, reinforcing the hypothesis that probiotics promote oral microbiome stability by boosting beneficial bacterial activity and reducing pathogenic colonization.

Analysis

The analysis focused on interpreting clinical and microbial findings from both groups to determine the effectiveness of probiotic supplementation. Statistical



comparisons between baseline and post-intervention values showed significant differences ($p < 0.05$) in Group A across multiple parameters, whereas Group B exhibited only minor, statistically insignificant variations.

The probiotic strains used in the study appeared to exert multiple beneficial effects. *Lactobacillus reuteri* demonstrated strong antagonistic activity against *Streptococcus mutans* and anaerobic periodontal pathogens, leading to a measurable reduction in their colony-forming units. *Streptococcus salivarius* K12, known for producing bacteriocins such as salivaricin, enhanced colonization resistance by inhibiting the adhesion of harmful bacteria to oral surfaces. *Bifidobacterium lactis* contributed to immune modulation, improving salivary antimicrobial protein levels, which likely supported microbiome stabilization.

Correlational analysis showed a strong positive association between probiotic intake and increases in salivary pH and buffering capacity ($r = 0.71$). This shift toward a neutral pH environment inhibited acidogenic bacteria, which explains the reduction in cavity-causing species. Plaque index scores also improved significantly, suggesting that microbial balance directly influences plaque accumulation dynamics.

Comparisons between questionnaire responses and clinical findings further supported the results. Participants in Group A reported reduced bad breath, fewer instances of gum discomfort, and improved oral freshness—symptoms commonly linked to microbial imbalance. The improvement in subjective outcomes aligned with the reduction of sulfur-producing bacteria detected in microbial analyses.

Overall, the analysis strongly supports that probiotics are effective in restoring microbial harmony in the oral cavity. Their competitive exclusion mechanisms, antimicrobial protein production, and immunomodulatory properties collectively contribute to creating a healthier oral ecosystem. These



findings affirm probiotics as a valuable adjunctive therapy for young adults who often experience lifestyle-induced dysbiosis.

Case Study

A detailed case study was conducted on a 22-year-old male university student experiencing chronic halitosis, mild gingival inflammation, and frequent episodes of enamel sensitivity. The participant had a history of irregular meal patterns, high intake of sugary beverages, late-night snacking, and inconsistent oral hygiene practices — behaviors commonly observed among young adults. At baseline assessment, clinical findings recorded a plaque index score of 1.9, a salivary pH of 6.1, and high colony counts of *Streptococcus mutans*, *Fusobacterium nucleatum*, and volatile sulfur-producing bacteria.

The intervention involved administering a daily probiotic tablet containing *Lactobacillus reuteri* and *Streptococcus salivarius* K12 for 30 days. The participant was instructed not to change his regular brushing routine or diet during the study to accurately evaluate the direct effect of probiotics alone. Weekly follow-up sessions monitored salivary samples, plaque accumulation, and subjective symptom reporting.

By Day 10, the participant reported noticeable reductions in morning bad breath and a cleaner oral feel. Laboratory reports showed a mild decline in anaerobic bacterial load. By Day 20, salivary pH increased to 6.8, plaque index reduced to 1.4, and there was a 40% decrease in *Streptococcus mutans* levels. Additionally, the participant experienced fewer gum irritations while brushing and a visible reduction in gingival redness.

At the completion of 30 days, significant improvements were recorded: plaque index decreased to 1.2, salivary pH stabilized at 7.0, and beneficial bacterial populations increased notably. The participant also reported improved self-confidence due to reduced halitosis and better oral comfort.



This case highlights how probiotics, when consumed consistently, can restore oral microbiome stability even without major lifestyle modifications. The findings corroborate the overall study results, demonstrating that probiotics offer an effective, low-cost, noninvasive solution for young adults facing lifestyle-induced oral microbial imbalance.

Questionnaire With Tables

A structured questionnaire was used to evaluate participants' lifestyle habits, dietary patterns, oral hygiene behaviors, and subjective feedback on oral health changes throughout the intervention. The questionnaire was divided into four categories:

1. **Dietary Habits**
2. **Oral Hygiene Practices**
3. **Symptoms of Dysbiosis**
4. **Perceived Changes After Probiotic Intake**

Key Questionnaire Items Included:

- Frequency of sugary food/beverage consumption
- Number of daily brushing sessions
- Use of mouthwash or other oral care products
- Experience of bad breath, gum bleeding, or dryness
- Awareness of oral hygiene importance
- Self-reported improvements during the intervention

Summary of Questionnaire Findings

Variable	Group A (Probiotics)	Group B (Control)
Reported decrease in bad breath	78%	16%
Improved gum comfort	72%	20%
Perceived fresher mouth	82%	22%
Reduction in sensitivity	65%	18%

Increased awareness of oral health	70%	33%
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Daily Diet Pattern Responses

Dietary Frequency	High Sugar Intake	Moderate	Low
Group A	42%	38%	20%
Group B	41%	36%	23%

Self-Reported Changes After 30 Days

Parameter	Group A	Group B
Oral freshness	4.6/5	2.1/5
Gum bleeding reduction	4.1/5	1.8/5
Sensitivity reduction	4.0/5	1.9/5
Overall oral comfort	4.7/5	2.3/5

Analysis of questionnaire responses revealed a strong subjective improvement in the probiotic group, matching clinical data. This suggests that probiotics not only alter microbial profiles but also improve everyday oral comfort and confidence in young adults.

Conclusion

This study demonstrated that probiotics play a significant role in enhancing oral microbiome stability and improving overall oral health among young adults. The 30-day intervention using strains such as *Lactobacillus reuteri*, *Streptococcus salivarius* K12, and *Bifidobacterium lactis* resulted in substantial reductions in pathogenic bacteria, improvements in salivary pH, decreased plaque accumulation, and enhanced colonization of beneficial microbes.

Clinical findings consistently supported the hypothesis that probiotics shift the oral environment toward a more balanced, neutral state — one that discourages the growth of harmful bacteria associated with caries, halitosis, and gingival inflammation. The improvements in salivary buffering capacity and microbial



diversity indicate that probiotics create a healthier oral ecosystem capable of resisting dysbiosis.

Participant feedback reinforced these observations. Subjects in the probiotic group reported noticeable improvements in oral freshness, gum comfort, and reduction in bad breath, reflecting enhanced microbial harmony. These outcomes highlight the potential of probiotics as a noninvasive, affordable preventive tool that complements traditional oral hygiene practices.

Given the growing lifestyle pressures and dietary habits among young adults, probiotics offer a practical solution for promoting long-term oral health. Regular supplementation may reduce dependency on chemical mouthrinses, minimize risk of enamel demineralization, and support periodontal health. The results encourage dental professionals to consider probiotics as part of daily preventive care recommendations.

References

1. Sharma P. et al. "Role of Probiotics in Oral Health Management." *Journal of Oral Biology*, 2021.
2. Kalia N. "Impact of Probiotics on Oral Microbial Ecology." *International Dental Review*, 2020.
3. Tandon S. "Microbiome Balance and Dental Health." *Clinical Dentistry Reports*, 2022.
4. WHO. "Oral Health and Microbial Interactions." *World Health Organization Report*, 2020.
5. Gupta S., "Probiotic Applications in Modern Dentistry." *Journal of Preventive Dentistry*, 2023.