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Review

Effect of Probiotics Administration on Oral Health Among Children

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Abstract

Probiotics are by definition live microbial feed supplements that, as shown in clinical trials, improve the host animal's gut microbial balance. Dietary changes, an increase in the consumption of indigestible carbohydrates, and the consumption of live bacteria with human origin are all methods for influencing the microflora. This latter idea is often frequently referred to as replacement therapy or bacteriotherapy. Due to their naturally occurring casein, calcium, and phosphorus content, milk products are regarded safe for teeth and may have positive effects on the salivary microbial composition and the suppression of caries development. Bifidobacteria are common in deep caries lesions in the mouth and may be crucial to the development of caries. Although the impact on people with the greater levels of salivary mutans streptococci has been found to be rather small, yogurt with living bacteria generally had a significantly lowering effect on these bacteria. Lactobacilli are more closely related to carious dentine and the progressing front of caries lesions than to the start of the dental caries process. They have the ability to create low molecular weight bacteriocins with inhibitory activity against a variety of bacterial species, including oral streptococci.

Keywords: *probiotics, pediatric dentistry, preventive dentistry, lactobacillus, bifidobacterial*

Introduction

The observation that the ingestion of fermented milk products containing live bacteria increased life spans led to the development of the probiotic bacterium myth. The theory was that pathogens harmful to health competed with the benign microorganisms in fermented items (1). Probiotics are by definition live microbial feed supplements that, as shown in clinical trials, improve the host animal's gut microbial balance (2). To survive the acid environment while traveling to the intestines, these bacteria must be a part of the normal flora. Probiotic bacteria can exert their effects in a number of ways, including by preventing pathogenic bacteria from adhering to cells and invading the intestinal environment, altering the intestinal environment by lowering pH as a result of fermentation products, and interacting with and controlling the local and systemic inflammatory immune response (3, 4). Strategies to promote health by modification of its microbial population have been developed as a result of the present understanding of the crucial role of the gut microflora (4). Dietary changes, an increase in the consumption of indigestible carbohydrates, and the consumption of live bacteria with human origin are all methods for influencing the microflora. This latter idea is often frequently referred to as replacement therapy or bacteriotherapy. According to conventional wisdom, pathogen-free microorganisms such species of lactobacilli and bifidobacteria can occupy a biofilm space that would otherwise be occupied by a harmless microorganism. Particularly in view of the frequent use of antibiotics with a subsequent risk for the development of resistant strains, there is an increasing interest in such an alternate method of treating infections. It seems sense to wonder if probiotics might also be active in the oral cavity by promoting health, given the competing event in the gastrointestinal system. Further, it has been increasingly evident that methods for eradicating particular endogenous microbes that are linked to caries have not only been shown to be challenging but possibly also impractical (5).

Origin and vehicles for probiotic delivery

The overwhelming bulk of the strains and species that are investigated in research for their probiotic characteristics are isolated from healthy persons, although there are some that come from fermentation. Probiotic bacteria are naturally occurring occupants of the intestinal flora. Probiotics are frequently discussed in relation to functional foods, a market that is expanding quickly in the European Union. However, the rising demand for replacement therapy has created a market for additional consumer goods such lozenges, sucking tablets, and chewing gum. There are four main methods that probiotics can be added to food; they are added to drinks (like fruit juice) as a culture concentrate, they are inoculated into prebiotic fibers that encourage the growth of probiotic bacteria, they are inoculated into prebiotic fibers which promote the growth of probiotic bacteria, they are consumed as lyophilized, dried cells packed as nutritional supplements as inoculated into milk and milk-based foods (such as milk drinks, yogurt, cheese, kefir, and biodrinks), and as inoculated into milk (tablets, chewing gums, straws). Yogurt is the prototypical probiotic food, and consuming dairy products regularly appears to be the most natural way to consume probiotic microorganisms (6). Due to their naturally occurring casein, calcium, and phosphorus content, milk products are regarded safe for teeth and may have positive effects on the salivary microbial composition and the suppression of caries development. This is an additional benefit of milk products for developing children. It is advised to consume 1.5–2 dL of a formulation containing around 108 probiotic bacteria per gram or milliliter on a daily basis. Dairy products should preferably be unsweetened and only include natural sugar. It has been noted that the dosage delivered through regular ingestion may not be sufficient for therapeutic benefit (7), and food preparation may worsen bacterial viability. When a product is nearing the end of its shelf life, viable counts may drop below recommended levels, and some bifidobacteria strains utilized in commercial probiotic food may not survive gastric transit. It's crucial to note that while a brand name often only contains one probiotic strain, a combination of strains can increase adherence in a synergistic way. This is because a single lactobacilli strain's efficiency does not necessarily imply that other strains will be equally effective (8). The inconsistent probiotic efficacy results reported in the early research are likely caused by variations between different strains of the same species. The majority of research now uses live lactobacilli strains derived from milk, although in recent years, findings on gums and pills have begun to surface.

Installation of probiotic bacteria

The digestive system is sterile before birth, but once the newborn is exposed to germs from the environment and the nutrition, colonization begins (9). The primary factor influencing the immune system's maturation after birth is

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the gut microbiota (10). Intestinal colonization is a rather complicated process that is regulated by host interactions, microbial exposure, and external and internal variables. The method of birth plays a significant role in determining the initial makeup of the flora, and infants delivered by cesarean section are less likely to have bifidobacteria colonized than children born vaginally (11). The impact of diet on gut bacterial colonization during the first month of life has been studied, and it has been found that children who are breastfed have more bifidobacteria and lactobacilli while children who are fed formula have more bacteroides, clostridia, and enterobacteriaceae (11, 12). This discrepancy could be explained by the presence of immune components in human milk, such as immunoglobulin A and lysosyme, which inhibit the growth of specific bacteria (13). Probiotics work in the digestive system by adhering to the intestinal mucosa and inhibiting gut pathogens as a result. Similar to this, probiotics in the oral cavity ought to cling to dental tissues as a component of the biofilm (or plaque) and inhibit the growth of cariogenic bacteria or periodontal pathogens (14). Several species of the native microflora colonize the epithelial surfaces in the mouth during and immediately after birth. These species have a tendency to stay in the mouth and may compete with other microbes to inhibit the growth of those that may invade later (15, 16). It is also worth noting that rivalry between *Lactobacillus rhamnosus* and *Streptococcus sobrinus* has been demonstrated in vitro by Meurman et al. It has been demonstrated that vaginally born babies are later occupied by cariogenic bacteria (17), which could be the consequence of such a competition among lactobacilli and streptococci. Vaginally born babies are exposed to more maternal as well as ecologic bacteria at birth than babies born via caesarean section. The first step toward an anticipated long-term benefit would be an early installation and colonization of probiotics in the oral environment, however the evidence for this is sparse. The probiotic bacteria were recovered in the majority of subjects during the interim days following intake, but overall, the findings did not support the possibility of a long-term installation. However, it should be noted that the studies were carried out on adults, and it may be questioned whether a permanent installation may happen easily in people who already have an established microflora (8). The probiotic product's rather brief contact with the plaque is probably not boosting this event. Daily intakes appear to be a requirement for potential activity because it seems unlikely that probiotics will continue to have any significant residual effects after withdrawal of intake (18). However, a unique reaction stands out, highlighting the host-dependent elements that influence colonization in general. For instance, a recent study revealed that the probiotic strain *L. rhamnus GG* was only momentarily detected in saliva after three daily probiotic juice intakes, not permanently installed (19). However, there was a significant variation seen, and in some people, probiotic bacteria could still be found 10–12 days after the last intake. Saliva samples may not accurately reflect the state of the oral biofilm, and probiotic strain combinations may work in concert to increase the likelihood of successful installation (8). Therefore, more research is required, including the cultivation of plaque samples. It also appears crucial to conduct studies on infants, as it is highly likely that regular exposure to probiotics beginning in infancy increases the likelihood of a permanent colonization.

Effects of probiotics on children's overall health

Lactobacillus acidophilus and *Bifidobacterium bifidum* were the first species to be used in probiotic investigation, and a variety of potential medical benefits have been mentioned, including lower incidence to infections, decreased allergies and lactose intolerance, as well as blood pressure control and serum cholesterol levels (8, 20). Youngsters with infantile colic have been found to have lower lactobacilli counts 34–36, and supplementing with *Lactobacillus reuteri* (ATCC 55730) helped the clinical manifestations of colicky children (21). Probiotic co-administration with conventional oral rehydration therapy greatly reduced the length of acute infectious diarrhea in babies and children, particularly diarrhea caused by rotavirus, according to one comprehensive review and two meta-analyses (22-24). The strength of the data proving the use of probiotics for various pediatric illnesses was examined in a review paper by Michail et al. They stated that the management of acute infectious diarrhea, the avoidance of antibacterial drugs related diarrhea, and the prevention and management of allergy symptoms have so far yielded the most robust evidence for the therapeutic effects in children. Other indicated illnesses such inflammatory bowel disease, irritable bowel syndrome, Crohn's disease, ulcerative colitis, and cancer prevention, however, had conflicting or nonexistent scientific data. Probiotic therapies are generally well-received, and there are very few recorded side effects or negative outcomes.

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Probiotic bacteria's impact on oral ecology

Bifidobacteria

Studies have been conducted to confirm the survival and beneficial benefits of *Bifidobacterium* DN-173 010 inside the digestive tract since the late 1980s, when a wide variety of dairy products containing bifidobacteria began to be marketed in numerous nations across the world (20). The majority of the anaerobes typically found in the small intestine lumen are bifidobacteria, which are essential for preserving the balance of the healthy intestinal flora. Bifidobacteria are common in deep caries lesions in the mouth and may be crucial to the development of caries (25). One study only reported the effects of probiotic bifidobacteria on oral ecology (26). In a double-blind, randomized, cross-over trial, two groups of young adults were randomly assigned to ingest probiotic yogurt containing *Bifidobacterium* DN-173 010 bacteria for two weeks, or a control yogurt devoid of live bacteria. It was determined that while the impact on people with the highest numbers of salivary mutans streptococci was rather little, yogurt with living bacteria generally had a significantly lowering effect on these bacteria. There were no changes noted in the salivary lactobacilli. Before being possible to make any judgments on bifidobacteria, more research must be done.

Lactobacilli

Since the 1980s, lactobacilli have attracted significant attention in dental research, and contemporary molecular methods have highlighted the idea that these bacteria are more closely related to carious dentine and the progressing front of caries lesions than to the start of the dental caries process (25). The phenomenon that *L. acidophilus* strains may suppress the in vitro development of other bacteria was initially described by Polonskaya 43, and this finding has subsequently been supported by several researchers. The ability of lactobacilli to create low molecular weight bacteriocins with inhibitory activity against a variety of bacterial species, including oral streptococci (27, 28), provides an explanation for this occurrence. Directly following the cessation of daily intakes, significant drops in salivary mutans streptococci were recorded in four of the five papers that assessed the impact of probiotics produced from lactobacilli on mutans streptococci (29-32). The daily administration vehicle—milk, cheeses, yogurt, lozenges, or prepared straws containing freeze-dried strains—seemed not to directly be related to the reduced post-treatment levels. For instance, in the trial by Caglar et al., young adults were randomized into four parallel groups, and the usage of lozenges and prepared straws was contrasted with placebo (32). Following two weeks of use, both regimens decreased the number of salivary mutans streptococci similarly. It was predicted that the gradually melting tablets would permit for more complete contact between the probiotic bacteria and the oral environment than the direct swallowing pattern through the straw. The findings might suggest that a positive effect does not require direct touch with oral tissues. Findings reported by Montalto et al. were comparable but also somewhat contradictory (33). When compared to a placebo, they looked into whether oral and systemic probiotic lactobacilli delivery may affect salivary counts of cariogenic bacteria. In order to ascertain the significance of direct contact with the oral tissues, the probiotic intervention was administered to willing volunteers both as liquid and as capsules. It was interestingly discovered that while the levels of mutans streptococci were similar, both methods of delivery considerably raised the salivary lactobacilli counts (33). This finding suggests that lactobacilli proliferation in the oral cavity may be enhanced by a pure systemic probiotic dosage. Although there is proof that sugar consumption affects oral lactobacilli and is linked to caries (34), the higher numbers were not thought to enhance the likelihood of developing caries. Firstly, the development of cavities is hardly ever aided by lactobacilli in general. Additionally, not all Lactobacillus species cause caries (35). Thirdly, a dairy-based carrier for lactobacilli is advantageous due to its buffering action, which may limit the acidogenicity of the bacteria. Although Nikawa et al. found that the acids from *L. reuteri* did have a minor impact on calcium release from the enamel, it has been shown that *L. rhamnosus* can gradually ferment sucrose and create lactic acid (29, 31). A practical outcome from a "safety-first" perspective would be to advise against recommending children with open, untreated dental cavities to regularly consume probiotics produced from lactobacilli until temporary fillings have been put. In one investigation, the idea that probiotic bacteria in cheese would lessen the prevalence of oral candida was put to the test (36). The study involved senior citizens, and the daily cheese consumption included a mix of lactobacilli and propionibacteria. After 16 weeks, the intervention group had a lower prevalence of salivary yeast, and the probiotic treatment reduced the likelihood of having high yeast counts by 75%. A basic point to keep in mind is that better dental health or fewer cavities are not always associated with a short- or long-term decrease in

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potentially hazardous bacteria in saliva. When it comes to topics that truly affect the patient, there is a clear paucity of probiotic research in dentistry. Only two randomized controlled trials using caries or gingivitis as an outcome measure were found (29, 37). The first trial involved preschool children aged 1-6 in Finland. For seven months, the experimental group received milk from their childcare centers five days a week that contained *L. rhamnosus GG*. Even though there was a noticeable decline in the number of mutans streptococci in the saliva, the impact on the progression of caries was less significant. The three to four-year-old age group had the best results, with 6% of kids in the test group experiencing fresh caries lesions throughout the trial period compared to 15% in the "normal milk" control group. However, it should be noted that the follow-up term was brief. To obtain one person who remained disease-free, 11 children had to be treated, hence 11 children had to be treated in total. The study was significant because it showed that, despite a relatively high dropout rate, it may be possible to prevent dental cavities in early children by a regular consumption of probiotic bacteria and that the effectiveness may differ by age. The effect of probiotic chewing gum on gingival conditions in people with moderate or severe gingivitis was examined in the second clinical investigation (37). In comparison to baseline and the placebo control group, gingival and plaque scores were observed to have dramatically decreased after 14 days of *L. reuteri* treatment. All of the clinical examinations were performed by a single examiner, but no validation or reproducibility studies of the indices were provided. Before any clinical advice to battle caries or periodontal infections can be made, more research with nonsurrogate endpoints and a lengthy duration, including health-economic evaluations, is needed.

Conclusion

Probiotic bacteriotherapy appears to be a natural strategy to preserve health and shield oral tissues against disease, and evidence indicate that the potential advantages rise with an early start in childhood. A regular intake of probiotic lactobacilli with an inhibitory impact on other bacteria is now most promising, but research is still in its early stages. One possible treatment for the long-term prevention of pediatric caries is milk, milk beverages, or yogurt that contains one or many probiotic strains. Nevertheless, before any clinical recommendations can be made, more double-blind, randomized controlled studies that evaluate specifically chosen and characterized probiotic strains utilizing predefined endpoints are required.

Disclosure

Conflict of interest

There is no conflict of interest

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Ethical consideration

Non applicable

Data availability

Data that support the findings of this study are embedded within the manuscript.

Author contribution

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

References

1. Metchnikoff II. The prolongation of life: optimistic studies: Springer Publishing Company; 2004.

2. Rasic JL. The role of dairy foods containing bifido- and acidophilus bacteria in nutrition and health? North Eur Dairy J. 1983;48:80-6.

3. Doron S, Gorbach SL. Probiotics: their role in the treatment and prevention of disease. Expert review of anti-infective therapy. 2006;4(2):261-75.

4. Fooks L, Gibson GR. Probiotics as modulators of the gut flora. British Journal of Nutrition. 2002;88(S1):s39-s49.

5. Zero DT, editor Dentifrices, mouthwashes, and remineralization/caries arrestment strategies. BMC Oral health; 2006: BioMed Central.

6. Caglar E, Kargul B, Tanboga I. Bacteriotherapy and probiotics' role on oral health. Oral diseases. 2005;11(3):131-7.

7. Cabana MD, Shane AL, Chao C, Oliva-Hemker M. Probiotics in primary care pediatrics. Clinical pediatrics. 2006;45(5):405-10.

8. Meurman JH. Probiotics: do they have a role in oral medicine and dentistry? European journal of oral sciences. 2005;113(3):188-96.

http://dx.doi.org/10.52533/JOHS.2022.21204

9. Tannock GW, Fuller R, Smith S, Hall M. Plasmid profiling of members of the family Enterobacteriaceae, lactobacilli, and bifidobacteria to study the transmission of bacteria from mother to infant. Journal of Clinical Microbiology. 1990;28(6):1225-8.

10. Edwards C, Parrett A. Intestinal flora during the first months of life: new perspectives. British Journal of Nutrition. 2002;88(S1):s11-s8.

11. Penders J, Thijs C, Vink C, Stelma FF, Snijders B, Kummeling I, et al. Factors influencing the composition of the intestinal microbiota in early infancy. Pediatrics. 2006;118(2):511-21.

12. Harmsen HJ, Wildeboer-Veloo AC, Raangs GC, Wagendorp AA, Klijn N, Bindels JG, et al. Analysis of intestinal flora development in breast-fed and formula-fed infants by using molecular identification and detection methods. J Pediatr Gastroenterol Nutr. 2000;30(1):61-7.

13. Edwards CA, Parrett AM. Intestinal flora during the first months of life: new perspectives. Br J Nutr. 2002;88 Suppl 1:S11-8.

14. Comelli EM, Guggenheim B, Stingele F, Neeser JR. Selection of dairy bacterial strains as probiotics for oral health. Eur J Oral Sci. 2002;110(3):218-24.

15. Cole MF, Bryan S, Evans MK, Pearce CL, Sheridan MJ, Sura PA, et al. Humoral immunity to commensal oral bacteria in human infants: salivary antibodies reactive with Actinomyces naeslundii genospecies 1 and 2 during colonization. Infect Immun. 1998;66(9):4283-9.

16. Könönen E, Kanervo A, Takala A, Asikainen S, Jousimies-Somer H. Establishment of oral anaerobes during the first year of life. J Dent Res. 1999;78(10):1634-9.

17. Li Y, Caufield PW, Dasanayake AP, Wiener HW, Vermund SH. Mode of delivery and other maternal factors influence the acquisition of Streptococcus mutans in infants. J Dent Res. 2005;84(9):806-11.

18. Busscher HJ, Mulder AF, van der Mei HC. In vitro adhesion to enamel and in vivo colonization of tooth surfaces by Lactobacilli from a bio-yogurt. Caries Res. 1999;33(5):403-4.

19. Yli-Knuuttila H, Snäll J, Kari K, Meurman JH. Colonization of Lactobacillus rhamnosus GG in the oral cavity. Oral Microbiol Immunol. 2006;21(2):129-31.

20. Fuller R. Probiotics in human medicine. Gut. 1991;32(4):439-42.

21. Savino F, Pelle E, Palumeri E, Oggero R, Miniero R. Lactobacillus reuteri (American Type Culture Collection Strain 55730) versus simethicone in the treatment of infantile colic: a prospective randomized study. Pediatrics. 2007;119(1):e124-30.

22. Szajewska H, Mrukowicz JZ. Probiotics in the treatment and prevention of acute infectious diarrhea in infants and children: a systematic review of published randomized, double-blind, placebo-controlled trials. J Pediatr Gastroenterol Nutr. 2001;33 Suppl 2:S17-25.

23. D'Souza AL, Rajkumar C, Cooke J, Bulpitt CJ. Probiotics in prevention of antibiotic associated diarrhoea: meta-analysis. Bmj. 2002;324(7350):1361.

24. Huang JS, Bousvaros A, Lee JW, Diaz A, Davidson EJ. Efficacy of probiotic use in acute diarrhea in children: a meta-analysis. Dig Dis Sci. 2002;47(11):2625-34.

25. Becker MR, Paster BJ, Leys EJ, Moeschberger ML, Kenyon SG, Galvin JL, et al. Molecular analysis of bacterial species associated with childhood caries. J Clin Microbiol. 2002;40(3):1001-9.

26. Caglar E, Sandalli N, Twetman S, Kavaloglu S, Ergeneli S, Selvi S. Effect of yogurt with Bifidobacterium DN-173 010 on salivary mutans streptococci and lactobacilli in young adults. Acta Odontol Scand. 2005;63(6):317-20.

27. Ishihara K, Miyakawa H, Hasegawa A, Takazoe I, Kawai Y. Growth inhibition of Streptococcus mutans by cellular extracts of human intestinal lactic acid bacteria. Infect Immun. 1985;49(3):692-4.

28. Silva M, Jacobus NV, Deneke C, Gorbach SL. Antimicrobial substance from a human Lactobacillus strain. Antimicrob Agents Chemother. 1987;31(8):1231-3.

29. Näse L, Hatakka K, Savilahti E, Saxelin M, Pönkä A, Poussa T, et al. Effect of long-term consumption of a probiotic bacterium, Lactobacillus rhamnosus GG, in milk on dental caries and caries risk in children. Caries Res. 2001;35(6):412-20.

30. Ahola AJ, Yli-Knuuttila H, Suomalainen T, Poussa T, Ahlström A, Meurman JH, et al. Short-term consumption of probiotic-containing cheese and its effect on dental caries risk factors. Arch Oral Biol. 2002;47(11):799-804.

http://dx.doi.org/10.52533/JOHS.2022.21204

31. Nikawa H, Makihira S, Fukushima H, Nishimura H, Ozaki Y, Ishida K, et al. Lactobacillus reuteri in bovine milk fermented decreases the oral carriage of mutans streptococci. Int J Food Microbiol. 2004;95(2):219-23.

32. Caglar E, Cildir SK, Ergeneli S, Sandalli N, Twetman S. Salivary mutans streptococci and lactobacilli levels after ingestion of the probiotic bacterium Lactobacillus reuteri ATCC 55730 by straws or tablets. Acta Odontol Scand. 2006;64(5):314-8.

33. Montalto M, Vastola M, Marigo L, Covino M, Graziosetto R, Curigliano V, et al. Probiotic treatment increases salivary counts of lactobacilli: a double-blind, randomized, controlled study. Digestion. 2004;69(1):53-6.

34. Stecksén-Blicks C. Lactobacilli and Streptococcus mutans in saliva, diet and caries increment in 8- and 13-year-old children. Scand J Dent Res. 1987;95(1):18-26.

35. Caufield PW, Li Y, Dasanayake A, Saxena D. Diversity of lactobacilli in the oral cavities of young women with dental caries. Caries Res. 2007;41(1):2-8.

36. Hatakka K, Ahola AJ, Yli-Knuuttila H, Richardson M, Poussa T, Meurman JH, et al. Probiotics reduce the prevalence of oral candida in the elderly--a randomized controlled trial. J Dent Res. 2007;86(2):125-30.

37. Krasse P, Carlsson B, Dahl C, Paulsson A, Nilsson A, Sinkiewicz G. Decreased gum bleeding and reduced gingivitis by the probiotic Lactobacillus reuteri. Swed Dent J. 2006;30(2):55-60.

http://dx.doi.org/10.52533/JOHS.2022.21204