International Journal of Dental Research and Allied Sciences
2025, Volume 5, Issue 1, Page No: 61-72

Available online at: www.tsdp.net

ISSN: 3062-3502

Original Article

Assessing the Effects of Kefir Intake on Tooth Decay and Gum Disease: A Narrative Synthesis

Ina Kayser[1*], Diana Heimes[1]

[1] General Outpatient Clinic of Sports Medicine, University of Leipzig, 04103 Leipzig, Germany.

***E-mail** ✉ Kayser.ina@yahoo.com

Received: 29 January 2025; **Revised:** 26 April 2025; **Accepted:** 05 May 2025

ABSTRACT

Dental caries and gum diseases are leading oral health issues worldwide, posing significant public health challenges. In recent years, kefir—a fermented beverage, either dairy- or water-based—has gained attention for its diverse microbial content and associated health benefits. This review aims to present a comprehensive update on the impact of kefir consumption on oral health. A search was performed across major research databases, including PubMed, Google Scholar, and Web of Science, utilizing keywords such as kefir, dental decay, probiotics, microbiota, gum disease, biofilm, and oral health to identify relevant human studies. The available evidence suggests that kefir may help reduce the presence of harmful bacteria commonly associated with oral diseases. Kefir appears to have the potential to reduce the growth of oral pathogens and inhibit biofilm formation, likely due to its ability to support a diverse microbial community in the mouth. This suggests that kefir could serve as a beneficial adjunct in preventing and managing dental decay and gum disease.

Keywords: Kefir, Dental decay, Probiotics, Oral microbiota, Gum disease, Biofilm, Oral health

How to Cite This Article: Kayser I, Heimes D. Assessing the Effects of Kefir Intake on Tooth Decay and Gum Disease: A Narrative Synthesis. Int J Dent Res Allied Sci. 2025;5(1):61-72. https://doi.org/10.51847/xvoKA3L0ae

Introduction

Maintaining oral health is integral to overall well-being, with dental decay and gum disease being two of the most widespread issues. Caries, or tooth decay, arises when bacterial acids break down tooth enamel, primarily due to the fermentation of carbohydrates in food [1]. According to the Global Oral Health Data Bank, dental caries affects 49% to 83% of the global population, while the World Health Organization (WHO) reports that nearly everyone will experience tooth decay in their lifetime [2]. Among children, dental caries remains a significant public health concern, affecting approximately half of preschool children globally [3].

Periodontal disease, an inflammatory condition affecting the gums and tooth-supporting structures, is largely caused by the accumulation of plaque. Contributing factors such as inadequate oral hygiene, diabetes, obesity, and pregnancy-related hormonal changes can aggravate the condition [4]. Between 1990 and 2019, the incidence of severe periodontal disease rose by approximately 540 million cases, marking a 24% increase globally. Low-income countries saw a 130% surge in cases, while high-income nations experienced a more moderate 51% rise [5].

These two oral conditions often interact, as poor hygiene and the presence of harmful bacteria contribute to both caries and periodontal disease. Sugar-rich diets, as well as rapid digestion of sugars like sucrose, glucose, and fructose, enable bacteria to form resilient biofilms on teeth, leading to an environment conducive to tooth decay and gum disease [6, 7]. Traditional treatments such as antibiotics, metal salts, and fluoride have been used against these harmful bacteria, although they are associated with side effects like tooth discoloration. For periodontal disease, treatment usually involves a combination of professional cleaning and pharmacological therapies tailored to the individual [8, 9].

Regular plaque removal, maintaining a balanced diet, and proper oral hygiene are key practices for preventing these conditions. Additionally, there is growing interest in probiotics as a potential complement to traditional oral care. These microorganisms have shown promise in preventing and treating biofilm-associated oral diseases, including tooth decay, gum diseases, oral infections, and bad breath [2, 10, 11].

Kefir, a fermented beverage containing diverse strains of probiotic bacteria and yeasts, has gained attention for its potential oral health benefits. The types of microorganisms present in kefir depend on the fermentation medium (typically dairy) and the kefir grains used, giving the drink distinct characteristics. Kefir's therapeutic properties are attributed to its ability to boost the immune system, while also exhibiting antimicrobial, anti-allergic, and anticancer effects [12-14]. Like other fermented foods, kefir may contribute to oral health by promoting a healthy balance of the oral microbiome. The microbial composition of kefir—particularly its Lactobacillus and Bifidobacterium strains—helps maintain oral balance by producing organic acids and antimicrobial compounds. Studies have shown that short-term consumption of kefir can increase the pH of saliva, thereby lowering the risk of tooth decay [15]. Additionally, kefir can reduce levels of Streptococcus mutans in saliva, an effect comparable to fluoride treatment [16]. Consuming kefir alongside probiotic toothpaste has also been linked to reduced microbial accumulation in patients undergoing orthodontic care [17].

These findings highlight kefir's potential as both a preventive and therapeutic supplement for dental caries and periodontal diseases. The integration of probiotics into dental care represents a modern approach, focusing on the oral microbiome's role in maintaining oral health. Understanding the interactions between oral microorganisms and health can lead to better prevention strategies and treatment options. This review examines existing research on kefir's role in preventing and treating tooth decay and gum disease.

Methodology

A thorough search was carried out in several academic databases, including PubMed, Google Scholar, and Web of Science, using a blend of keywords such as *kefir*, *dental caries*, *periodontal diseases*, *probiotics*, *microbiota*, *biofilm*, and *oral health*. In addition to these terms, Medical Subject Headings (MeSH) were incorporated to focus the results specifically on human-related studies.

Probiotics

According to the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), probiotics are live microorganisms that, when consumed in appropriate amounts, can provide beneficial effects for the host [18]. These microorganisms play a crucial role in managing the balance of the oral microbiota by reducing harmful bacteria, thereby offering a promising alternative for oral health maintenance [12, 16, 18]. Numerous studies have highlighted the positive influence of probiotics, which include inhibiting harmful bacteria, modulating the gut microbiome, and reducing systemic inflammation [19].

Probiotics can impact oral inflammatory diseases through both direct and indirect mechanisms. Indirect effects involve regulating local and systemic immune responses, adjusting mucosal permeability, and competing for colonization sites. On the other hand, direct mechanisms include blocking plaque buildup, competing for nutrients, and producing antimicrobial compounds [20]. These benefits arise from mechanisms like enhanced adhesion to mucosal surfaces, secretion of antibacterial agents, and the exclusion of pathogenic microbes [21].

In the case of periodontal disease, probiotics can help by converting dietary and endogenous substances into antimicrobial and anti-inflammatory metabolites, reducing both harmful bacteria and inflammation. These mechanisms suggest that probiotics have the potential to be valuable adjuncts in managing periodontitis and improving periodontal health [22].

Probiotics are consumed in various forms, such as supplements, preventive treatments, or functional foods, and are crucial in preventing and managing oral conditions like dental cavities, periodontitis [23], halitosis [24], oral thrush [25], and gum diseases [26, 27]. **Table 1** outlines some commonly used bacterial and yeast species for oral probiotic products. In this context, milk and water kefir are functional beverages containing probiotics that could benefit oral health [13, 28, 29].

Table 1. Probiotic Bacteria and Yeast Strains for Oral Health

Bacterial Group	Strain	Source Citations
Lactobacillus	bulgaricus	[30, 31]
	acidophilus	[30, 31]
	casei	[30, 31]
	paracasei	[30, 31]

	helveticus	[30, 31]
	lactis	[30, 31]
	salivarius	[30, 31]
	plantarum	[30, 31]
	reuteri	[30, 31]
Streptococcus	oralis	[30]
	uberis	[30]
	rattus	[30]
	salivarius	[30]
	thermophilus	[30]
Enterococcus	faecium	[32]
	faecalis	[32]
Bacillus	coagulans	[30]
Saccharomyces	cerevisiae	[33, 34]
	boulardii	[33, 34]

Milk Kefir (Dairy-Based Kefir)

The term *kefir* originates from the Turkish word *kef*, meaning "pleasant taste." Milk kefir is a traditional fermented drink that has been made for centuries in the Caucasus region by fermenting milk with kefir grains. These grains are typically between 1 to 6 mm in size, though they can grow up to 15 mm, with a rough, cauliflower-like appearance and a white or cream color [13, 19, 28]. Kefir grains contain a variety of bacteria and yeasts, such as *Lactobacillus spp.*, *Lactococcus spp.*, *Leuconostoc spp.*, *Pediococcus*, and *Streptococcus spp.*, along with yeasts like *Candida spp.* and *Saccharomyces spp.*. These microbes interact with milk and sugars, producing kefiran, a polysaccharide matrix that facilitates the fermentation process [28, 30]. Research has shown that milk kefir inhibits the growth of various gram-negative bacteria, including *Salmonella typhi*, *Escherichia coli*, *Pseudomonas fluorescens*, and *Pseudomonas aeruginosa*. Additionally, it has antibacterial properties against gram-positive bacteria like *Listeria monocytogenes*, *Staphylococcus aureus*, *Bacillus subtilis*, and *Enterococcus faecalis*. This antibacterial activity is thought to stem from an increase in membrane permeability, which damages bacterial cells and leads to their destruction [13].

In recent years, various studies have explored the health benefits of milk kefir and its bioactive compounds, which exhibit antimicrobial, anticancer, antihypertensive, anti-inflammatory, antidiabetic, and antioxidant properties, along with supporting immune system function [13, 28, 35-41]. Human studies have also indicated that kefir may aid in maintaining gut balance, particularly in COVID-19 patients, where it improved certain inflammatory markers, although it did not significantly affect the disease's symptoms [42]. However, despite these findings, there is limited clinical evidence available on the direct impact of kefir on oral health, with most research conducted in specific regions of Asia and Europe, as shown in **Table 2**.

Table 2. Summary of Clinical Investigations on Kefir

Study Type/Region/Source	Research Method	Consumption Volume/Period	Bacterial Profile	Number of Volunteers	Primary Findings
Controlled Experimental Trial/Turkey/[43]	Subjects ingested kefir, and stimulated saliva was examined for S. mutans and Lactobacilli counts.	100 mL or 200 mL daily for 3 weeks	Lactococcus lactis subsp. lactis, Lactococcus lactis subsp. cremoris, Lactococcus lactis subsp. diacetylactis, Leuconostoc mesenteroides subsp. cremoris, Lactobacillus kefyr, Kluyveromyces marxianus, Saccharomyces unisporus	104 individuals (55 women, 49 men), aged 20–27 years	Marked reduction in S. mutans levels.
Randomized Crossover Experiment/Iran/[16]	Group A drank kefir, Group B used 0.5% NaF mouthwash without kefir. Pre- and post-intervention unstimulated saliva was analyzed for pH and S. mutans levels.	100 mL daily for 4 weeks	Lactobacillus casei subsp. pseudo plantarum, Saccharomyces cerevisiae	22 healthy individuals (11 men, 11 women), aged 22–32 years	Kefir reduced S. mutans in saliva comparably to sodium fluoride mouthwash; pH levels showed no notable change.
Observational Analysis/India/[44]	Groups consumed milk kefir, probiotic	100 mL of probiotics daily for 1 month	Lactobacillus casei subsp. pseudo plantarum,	80 healthy children,	Milk kefir group exhibited lower S. mutans

	curd, a probiotic beverage, or served as controls. Saliva was tested before and after dental restorations and probiotic intake.		Saccharomyces cerevisiae	aged 8–12 years	colony-forming units compared to controls over a one-month weekly monitoring period.
Stratified Randomized Study/Turkey/[17]	One group used probiotic toothpaste, another ingested kefir, and a control group avoided kefir. Stimulated saliva was assessed for S. mutans and Lactobacillus counts.	200 mL daily for 6 weeks	Lactococcus lactis subsp., Leuconostoc sp., Lactobacillus sp., S. thermophilus, yeasts from kefir grains	45 orthodontic patients, aged 14 ± 2 years	Brief kefir consumption and probiotic toothpaste use lowered Lactobacillus sp. counts compared to the control group.
Cross-Sectional Analytical Study/Iran/[45]	Multistage cluster random sampling from eight schools, using cluster and systematic approaches. Beverage intake frequency was documented, and dental assessments were performed by a WHO-certified examiner.	Unspecified volume, 3 months	Not detailed	600 adolescents (300 women, 300 men), aged 12–15 years	A survey on beverage frequency indicated that daily milk kefir intake reduced the tooth decay index and dental erosion.
Randomized Controlled Study/Turkey/[46]	Kefir group consumed morning kefir without rinsing; controls received no additional products. Subgingival plaque was sampled at months 1 and 3 to evaluate red complex bacteria levels.	250 mL once daily for 14 days over 3 months	Not detailed	36 participants, aged 18–70 years	Kefir enhanced periodontal clinical and bacterial outcomes, similar to other probiotics, with no significant differences in initial (T0) clinical measures.

Water Kefir (Non-Dairy Kefir)

The exact origin of water kefir remains uncertain, although it is believed that the original grains may have originated from the Opuntia fig plant [28, 47]. Water kefir grains are typically smooth and lack the visible sub-granules found in milk kefir. These grains have a grayish color, which can vary depending on the fruits or vegetables used during fermentation [28, 48]. The typical size of water kefir grains ranges from 5 to 20 mm [47].

The bacteria responsible for the fermentation of water kefir include *L. casei*, *Leuconostoc mesenteroides*, *L. nagelli*, *L. hordei*, and *L. hilgardii*, along with acetic acid bacteria and yeasts [47, 49].

While both water and milk kefir share similar probiotic properties, they differ in their microbial composition due to the substrates used for fermentation. Water kefir is made up of approximately 70% *Lactobacillus* species, 10% *Leuconostoc* species, 10% *Acetobacter* species, 5% *Bifidobacterium* species, and 5% other bacteria, whereas milk kefir contains about 50% *Lactobacillus* species, 20% *Leuconostoc* species, 10% *Streptococcus* species, 8% *Pediococcus* species, and 7% *Lactococcus* species [28]. These variations influence the antimicrobial properties and probiotic benefits, such as non-pathogenicity, tolerance to stomach conditions, adhesion to intestinal walls, and competition with harmful microorganisms [49].

In vitro and in vivo research on water kefir has demonstrated its ability to combat bacteria like *Candida albicans*, *Salmonella typhi*, *Shigella sonnei*, *Staphylococcus aureus*, and *Escherichia coli* [50]. Although studies on its immunomodulatory and anti-inflammatory effects are limited, some findings suggest that water kefir can help regulate inflammation [51, 52]. Additionally, water kefir has been shown to possess antioxidant properties and may promote the production of bioactive compounds, such as dextran, during prolonged fermentation [53]. Certain strains of water kefir have also exhibited antihyperglycemic effects [54].

Polymicrobial Community

The mouth is home to a vast variety of microorganisms that collectively make up the oral microbiota. A balanced interaction between these microbes and the host is vital for the health of the periodontium. These microorganisms play essential roles in both maintaining oral health and contributing to disease development, influenced by a variety of clinical and risk factors [55]. Dental plaque consists of a diverse group of microorganisms that can interact with eukaryotic cells, thereby affecting both local and systemic health, and influencing the onset of diseases [2, 56].

In the development of dental caries, several acid-producing species form cariogenic communities, including *Lactobacillus spp.*, *Bifidobacterium spp.*, *Actinomyces spp.*, *Propionibacterium spp.*, *Corynebacterium spp.*, *Granulicatella spp.*, and *Scardovia spp.* [57, 58]. *Streptococcus mutans* and *Streptococcus sobrinus* are central to the creation of the biofilm matrix, and their metabolic byproducts enhance the growth of other pathogenic species, enriching the cariogenic environment [10].

In their 1998 study, Socransky *et al.* [59] identified four microbial complexes based on their color patterns: the red complex, associated with periodontal disease; the yellow complex, indicative of healthy periodontal conditions; and the orange complex, which includes periodontal pathogens. The red complex—*Tannerella forsythia*, *Porphyromonas gingivalis*, and *Treponema denticola*—has now been identified as key contributors to advanced periodontal disease. More recent findings have revealed a more intricate picture of periodontitis, showing that it results from polymicrobial interactions and dysbiosis that disrupt the stable biofilm environment critical for periodontal health [4].

Research by Abu Fanas *et al.* [60] highlighted the presence of new periodontal pathogens and bacterial complexes in Stage II generalized periodontitis. Their results confirmed the dysbiotic nature of the microbial community in periodontitis. The process starts with early colonizers such as *Streptococcus* species (yellow complex), which adhere to the tooth surface and lay the groundwork for secondary colonizers like *Actinomyces naeslundii* and *Veillonella atypica* (purple and green complexes). These organisms create an environment favorable for the red complex bacteria, including *Fusobacterium nucleatum*, which thrive under anaerobic conditions. This progression, from a healthy microbiota to initial dysbiosis in gingivitis and later full dysbiosis in periodontitis, demonstrates how immune responses lead to tissue damage. These findings stress the need to understand microbial dynamics to develop more effective treatments and intervention strategies.

Dental Caries

Dental caries is primarily caused by changes in the biofilm's composition, which is influenced by diet, particularly the intake of carbohydrates. This leads to the proliferation of pathogenic bacteria and the formation of lesions in the enamel caused by acid-producing microorganisms [2, 57, 61, 62]. Some of these acidogenic bacteria can colonize the tongue's epithelial surface, serving as reservoirs for plaque that forms on both supragingival and subgingival surfaces [1, 7, 62]. The process begins with the coating of the tooth surface by salivary glycoproteins, followed by the production of exopolysaccharides (EPSs) and acidic metabolites by species like *S. mitis* and *S. mutans*. These metabolites aid in the attachment of additional microorganisms and the initiation of dental caries [2]. EPS production provides binding sites for bacteria, facilitated by the formation of glucans via glycosyltransferases (Gtf B, Gtf C, and Gtf D). The binding of bacteria to these glucans occurs through specific proteins such as GBpA, GBpB, GBpC, and GBpD. Research has shown that GBpB and GBpC are crucial receptors for glucans, contributing significantly to bacterial attachment and biofilm formation [47].

Research has also found *Candida albicans* in the plaque of children, where it interacts with *S. mutans* to colonize tooth surfaces. *S. mutans* exoenzymes bind to *C. albicans* and synthesize glucans, leading to the formation of mixed biofilms. This phenomenon illustrates how polymicrobial communities can work synergistically, influenced by dietary sugars and other host factors [57].

Oral bacteria that rely on sucrose fermentation produce acids that lower the biofilm pH to 5.0 or below, disrupting microbial communities and disturbing the mineral balance of the enamel. This results in tooth mineral dissolution and supports the growth of cariogenic bacteria [12, 61]. Maintaining a stable pH in the oral environment is crucial. This can be achieved by reducing sugar intake and regularly removing biofilms, which helps maintain microbial balance. Saliva neutralizes the acid, preventing long-term acidity that could cause damage [57].

In addition to nutrient availability, microbial factors such as the transfer of resistance genes, the complexity of the biofilm matrix, and the protection offered by EPS contribute to the development of dental caries [2]. Other factors, such as poor oral hygiene, changes in saliva composition, and inadequate fluoride exposure, also play a role [57]. The acid produced by bacterial fermentation affects the balance of calcium (Ca2+), phosphate (PO4)3-, and fluoride ions, promoting demineralization and the formation of caries lesions.

Periodontal Diseases

Periodontal diseases begin when biofilms accumulate on the tooth surfaces, triggering an immune response to microbial antigens perceived as danger signals. These biofilms disrupt the oral microbial balance, causing a dysregulated and often destructive immune response [63]. Gingivitis, an inflammatory disease affecting the gums, is a critical risk factor and precursor to periodontitis. Chronic periodontitis is characterized by the destruction of the tissue connecting the gums to the teeth, the formation of periodontal pockets, the degradation of the periodontal ligament, and the loss of bone surrounding the teeth [4]. Several risk factors contribute to periodontal diseases, including systemic conditions like diabetes, obesity, smoking, poor diet, stress, and inadequate oral hygiene [64].

Discussion

In recent years, the focus of oral health research has shifted towards exploring probiotic-based products as potential preventive measures against dental caries and periodontal conditions. Some beverages, including fermented drinks, have shown encouraging results in lowering salivary bacterial counts, thus helping to protect enamel from demineralization [12, 43]. Probiotics help maintain a neutral pH within the oral cavity, which plays a critical role in the remineralization process, further supporting long-term oral health [30].

The key mechanism by which probiotics contribute to oral health is through competitive exclusion, where they compete with harmful bacteria for space on tooth surfaces. Additionally, probiotics produce substances such as bacteriocins and hydrogen peroxide, which directly inhibit the growth of pathogenic microorganisms [43, 65].

Probiotic yogurt, particularly when consumed by infants, has been shown to offer benefits for oral health, including improved buffering capacity, which can help combat caries. Both yogurt and kefir have been found to inhibit the action of glucosyltransferases (GTF), enzymes that break down sucrose into fructose. This disruption of *Streptococcus mutans*' cariogenic activity suggests that these dairy products may play a role in caries prevention [66, 67].

The equilibrium between different microbial populations is essential for preserving oral health. Fermented beverages, such as kefir, which are rich in beneficial probiotics, may assist in maintaining eubiosis. This state of microbial harmony ensures that the beneficial microorganisms thrive while harmful ones are kept in check, leading to a healthier oral environment [68].

There is growing interest in using probiotics as a complementary treatment to regulate inflammation within the oral cavity. These probiotics help restore balance to the oral microbiome, reduce inflammation, and thus complement conventional therapeutic approaches. This method is especially valuable for patients who experience chronic inflammatory responses due to various factors, such as genetics or environmental influences, and may not respond sufficiently to standard treatments. Understanding the limitations of traditional approaches emphasizes the need for innovative solutions, such as kefir consumption, to manage periodontal diseases more effectively [69].

Long-term consumption of kefir can have far-reaching benefits for systemic health by supporting gut microbiota, reducing inflammation, and enhancing immune functions. Kefir promotes the growth of beneficial gut bacteria like *Lactobacillus* and *Bifidobacterium*, which help strengthen the gut lining and improve digestion. Kefir's anti-inflammatory and immunomodulatory properties also contribute to managing systemic inflammatory conditions and reducing the risk of diseases like type 2 diabetes and heart disease [29, 70]. Moreover, kefir's potential to improve lipid profiles, aid weight management, and influence the gut-brain connection could positively affect mood and cognitive function [70]. These systemic benefits highlight kefir's value as a health-promoting food.

Table 2 outlines recent studies evaluating kefir's impact on caries prevention and periodontal health in human subjects. The results consistently indicate that milk kefir plays a protective role, although more research is needed to establish the effects of water kefir. Among the studies, three focused on children and adolescents, with each study adhering to consistent inclusion criteria, such as prior knowledge of oral hygiene practices and baseline oral health measurements [17, 44, 45]. The studies revealed a reduction in the presence of cariogenic bacteria, with only two specifying kefir dosage. The protocols varied, but the most significant results came from a study that combined kefir use with toothpaste. Given the diverse microbial community in kefir, it is still unclear whether its effects are due to specific probiotic strains or the synergistic action of the entire microbial population [17]. Additionally, one study that relied on questionnaire responses to determine kefir intake introduced the possibility of bias [44]. A separate study found that kefir was just as effective as a sodium fluoride mouth rinse in reducing salivary *S. mutans* levels in participants aged 22–32 [28]. The findings from Alp *et al.* and Çoğulu *et al.* [17, 43] suggest that kefir's efficacy in combating cariogenic bacteria may be linked to its microbial diversity and is also dependent on the dosage, with larger quantities yielding better results.

Milk-based products, including kefir, have a natural ability to buffer acids, which helps prevent tooth decay [45]. Sheep's milk, in particular, enhances probiotic cultures and the production of bioactive peptides that protect enamel from demineralization [71, 72]. The thick texture of milk kefir allows it to adhere to the teeth for extended periods, further contributing to its protective effects on enamel [17, 43]. During fermentation, kefir produces enzymes such as invertases and hydrolases, which break down sugars and lipids, generating various metabolites that support the growth of beneficial microorganisms [73].

Although the precise mechanisms by which kefir combats dental caries are not fully understood, it is believed that kefir's probiotic strains help balance the oral environment. This balance promotes the development of beneficial biofilms and produces antimicrobial substances such as bacteriocins, hydrogen peroxide, and organic acids. These substances compete with harmful bacteria like *S. mutans* for adhesion sites, while also lowering the pH of plaque, making it less favorable for pathogenic organisms to thrive [43, 73].

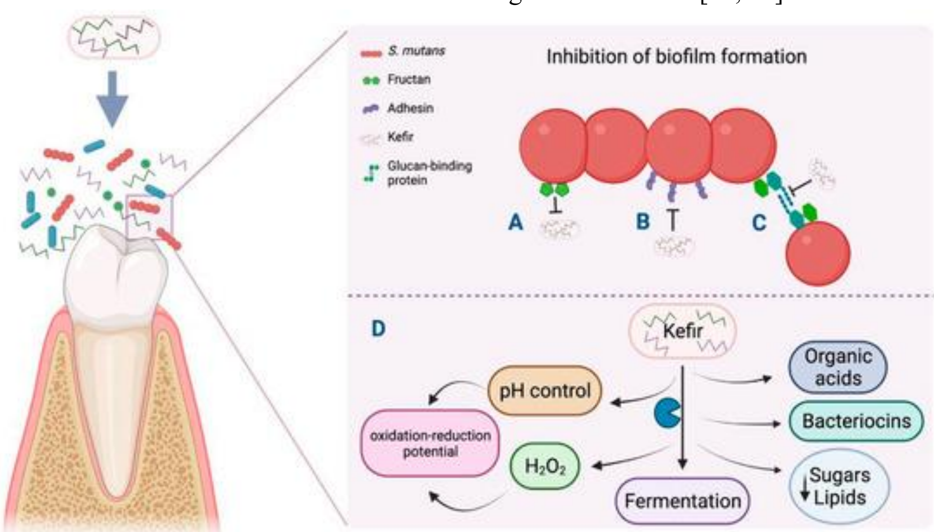

Figure 1. Mechanism of kefir's antibiofilm effect in dental caries by inhibiting carbohydrate metabolism. Created with Biorender (https://biorender.com/k37q453, accessed on 24 November 2024)

In vitro studies have indicated that strains of *Lactobacilli* derived from milk kefir could help combat caries by influencing biofilm formation, with genes linked to this process playing a key role. For instance, the strain *L. kefiranofaciens*, found in kefir, has shown to inhibit the growth of *S. mutans*. It achieves this by affecting the gene expression tied to biofilm development and carbohydrate metabolism. This downregulation results in reduced production of fructans and diminished adhesion, lowering biofilm formation by preventing bacteria from binding through glucans and adhesins **(Figure 1)** [10]. Early trials have demonstrated that administering *L. paracasei* can suppress *S. mutans* colony growth [74], while *L. rhamnosus*, in either milk powder or fermented form, also reduces *S. mutans* CFUs [75]. These findings highlight the potential of kefir in future anti-caries treatments.

Diabetes Mellitus, a common condition co-occurring with periodontal disease, is influenced by systemic inflammation that impairs glucose regulation. Certain strains from water kefir have exhibited potential to reduce blood sugar levels [54], suggesting that water kefir might be a promising area for clinical research, especially in non-vulnerable populations.

While there's limited research on how kefir directly affects gum health, the broader role of probiotics in oral care is clear. Probiotics can significantly reduce harmful oral pathogens and improve critical markers related to periodontal health, such as plaque index, gingival index, and pocket depth. These beneficial microorganisms may also aid in regulating immune responses, presenting a multifaceted strategy to manage periodontal disease and enhance overall oral health outcomes [76].

Although metagenomic studies on kefir's effects on the oral microbiome are scarce, its influence on the gut microbiome is well-documented. Kefir contains high levels of lactic acid bacteria (8-10 log CFU/mL), which thrive and colonize the gut. Research by Hamet *et al.* [77] noted that kefiran exhibits a bifidogenic effect, promoting the growth of *Bifidobacterium* in animal models. Though kefir's direct effects on the oral microbiome remain under-researched, its impact on gut health suggests it could offer similar benefits to the oral cavity, making further exploration of its oral health-related by-products worthwhile.

The challenges of using kefir as a treatment stem primarily from variability in production and dosage. The composition of kefir varies depending on factors such as the grain's origin, fermentation process, and substrates used, leading to differences in probiotic strains and concentrations. Kefir's live microorganisms are also sensitive to storage conditions, which may impact their efficacy [28]. Additionally, individual differences in microbiota and cultural or dietary preferences can influence kefir's effectiveness, particularly in immunocompromised individuals. Addressing these concerns will be crucial for unlocking kefir's full therapeutic potential.

Determining the optimal dosage of kefir is also uncertain. In clinical studies, kefir doses typically range from 100 mL to 500 mL daily, consumed over weeks or months depending on the desired outcome. This range allows for flexible intake, though the specific dosage may need to be adjusted based on the individual's tolerance and the health goals being pursued. A suggested personalized dosing approach, based on body weight, is 1.6 mL per kg of body weight per day. For instance, a 90 kg individual would take approximately 144 mL of kefir daily. This method could help standardize kefir consumption in clinical studies, allowing for more consistent results [78].

Although kefir is generally regarded as safe, research on its side effects, especially in sensitive populations like children or immunocompromised individuals, remains limited. Some studies have found a connection between probiotic use and infections caused by common probiotic organisms, though this is rare. On the other hand, a study on critically ill patients did not report any kefir-related complications, aside from mild diarrhea in a few cases [79-80]. Moreover, a recent study found that kefir reduced *Candida albicans* levels in chemotherapy patients without adverse effects on their immune systems [81]. While these results are promising, more research is necessary to ensure kefir's safety for vulnerable populations.

In conclusion, kefir offers a valuable adjunct to oral health care, especially for caries and periodontal disease, in the short term. Future research, including both short- and long-term clinical trials, is needed to fully understand the effects of kefir on dental health, identify the most effective strains, and determine the optimal administration methods. Though preliminary studies provide insight into the microorganisms and compounds in kefir responsible for these benefits, additional research will clarify how kefir can best be utilized for oral health.

Kefir inhibits glucosyltransferase—which contributes to the formation of fructans, binding sites for *S. mutans*—and reduces the expression of genes responsible for producing adhesion proteins, thus preventing bacterial clustering and biofilm creation (B and C). Kefir also affects caries-related factors such as pH regulation and metabolite production during fermentation. (D) The figure was created with BioRender.com.

Limitations

This study has several limitations, including the absence of a meta-analysis due to the variability among the sample populations. It's also important to note that the focus of this research was on regions in countries like Iran, India, and Turkey, which span Asia and Europe (Turkey being a transcontinental country). The geographic focus could be influenced by cultural factors, as probiotic beverages have long been integrated into the diets of ancient civilizations in these regions.

Although the probiotic benefits of kefir for oral health are widely acknowledged, current research reveals substantial gaps that require further exploration. A systematic review published in 2023 highlighted the potential of probiotics to reduce oral pathogens and improve plaque and gingival indices. However, it did not specifically address kefir-based interventions, pointing to a need for focused studies on kefir's role in oral health [83]. Furthermore, while probiotics have shown promise in managing dental diseases, there is insufficient research on the specific strains and dosages of kefir necessary to develop standardized therapeutic guidelines. For example, a recent clinical trial found that kefir, when combined with initial periodontal treatment, improved clinical periodontal indices, suggesting kefir's potential in managing periodontal disease [46].

Kefir is recognized for its antimicrobial and anti-inflammatory properties, but further research is required to better understand its precise effects on oral health and the oral microbiome. To fill this knowledge gap, well-structured clinical trials are needed to evaluate kefir's effectiveness in preventing and managing dental caries and periodontal diseases. These studies could provide essential data to inform clinical and public health practices.

Conclusions

In conclusion, this study updates the existing knowledge on kefir's benefits for managing dental caries and periodontal disease. Kefir, with its minimal side effects, holds promise as both a preventive and adjunctive treatment for oral health. Future research should aim to clarify the mechanisms by which kefir influences the oral microbiome and modulates inflammation. Well-conducted clinical trials are needed to confirm kefir's effectiveness and explore its potential applications in the field of dentistry.

Acknowledgments: None

Conflict of Interest: None

Financial Support: None

Ethics Statement: None

References

1. Chugh P, Dutt R, Sharma A, Bhagat N, Dhar MS. A critical appraisal of the effects of probiotics on oral health. J Funct Foods. 2020;70:103985.
2. Chen X, Daliri EB-M, Kim N, Kim J-R, Yoo D, Oh D-H. Microbial etiology and prevention of dental caries: Exploiting natural products to inhibit cariogenic biofilms. Pathogens. 2020;9:569.
3. Uribe SE, Innes N, Maldupa I. The global prevalence of early childhood caries: A systematic review with meta-analysis using the WHO diagnostic criteria. Int J Paediatr Dent. 2021;31:817–30.
4. Hajishengallis G. Interconnection of periodontal disease and comorbidities: Evidence, mechanisms, and implications. Periodontol 2000. 2022;89:9–18.
5. World Health Organisation. Global oral health status report: Towards universal health coverage for oral health by 2030. Geneva: WHO; 2022. Available from: https://www.who.int/publications/i/item/9789240061484
6. Takahashi N, Nyvad B. The role of bacteria in the caries process: Ecological perspectives. J Dent Res. 2011;90:294–303.
7. Nomura Y, Otsuka R, Wint WY, Okada A, Hasegawa R, Hanada N. Tooth-level analysis of dental caries in primary dentition in Myanmar children. Int J Environ Res Public Health. 2020;17:7613.
8. Sanz M, Herrera D, Kebschull M, Chapple I, Jepsen S, Beglundh T, et al. Treatment of stage I–III periodontitis—The EFP S3 level clinical practice guideline. J Clin Periodontol. 2020;47:4–60.
9. Herrera D, Sanz M, Kebschull M, Jepsen S, Sculean A, Berglundh T, et al. Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline. J Clin Periodontol. 2022;49:4–71.
10. Jeong D, Kim DH, Song KY, Seo KH. Antimicrobial and anti-biofilm activities of Lactobacillus kefiranofaciens DD2 against oral pathogens. J Oral Microbiol. 2018;10:1472985.
11. Farias da Cruz M, Baraúna Magno M, Alves Jural L, Pimentel TC, Masterson Tavares Pereira Ferreira D, Almeida Esmerino E, et al. Probiotics and dairy products in dentistry: A bibliometric and critical review of randomized clinical trials. Food Res Int. 2022;157:111228.
12. Magno MB, Nadelman P, De Abreu Brandi TC, Pithon MM, Fonseca-Gonçalves A, Da Cruz AG, et al. The effect of dairy probiotic beverages on oral health. In: Milk-Based Beverages: Volume 9: The Science of Beverages. Cambridge: Woodhead Publishing; 2019.
13. Azizi NF, Kumar MR, Yeap SK, Abdullah JO, Khalid M, Omar AR, et al. Kefir and its biological activities. Foods. 2021;10:1210.
14. Farag MA, Jomaa SA, El-wahed AA, El-seedi HR. The many faces of kefir fermented dairy products: Quality characteristics, flavour chemistry,

nutritional value, health benefits, and safety. Nutrients. 2020;12:346.

15. Srivastava S, Saha S, Kumari M, Mohd S. Effect of probiotic curd on salivary pH and Streptococcus mutans: A double blind parallel randomized controlled trial. J Clin Diagn Res. 2016;10:ZC13–16.
16. Ghasempour M, Sefdgar SAA, Moghadamnia AA, Ghadimi R, Gharekhani S, Shirkhani L. Comparative study of kefir yogurt-drink and sodium fluoride mouth rinse on salivary mutans streptococci. J Contemp Dent Pract. 2014;15:214–7.
17. Alp S, Baka ZM. Effects of probiotics on salivary Streptococcus mutans and Lactobacillus levels in orthodontic patients. Am J Orthod Dentofac Orthop. 2018;154:517–23.
18. FAO. Probiotics in food. Health and nutritional properties and guidelines for evaluation. Rome: FAO; 2006. Available from: https://openknowledge.fao.org/server/api/core/bitstreams/382476b3-4d54-4175-803f-2f26f3526256/content
19. Gut AM, Vasiljevic T, Yeager T, Donkor ON. Kefir characteristics and antibacterial properties—Potential applications in control of enteric bacterial infection. Int Dairy J. 2021;118:105021.
20. Homayouni Rad A, Pourjafar H, Mirzakhani E. A comprehensive review of the application of probiotics and postbiotics in oral health. Front Cell Infect Microbiol. 2023;13:1120995.
21. Maftei NM, Raileanu CR, Balta AA, Ambrose L, Boev M, Marin DB, et al. The potential impact of probiotics on human health: An update on their health-promoting properties. Microorganisms. 2024;12:234.
22. Lee Y, Yoon Y, Choi KH. Probiotics-mediated bioconversion and periodontitis. Food Sci Anim Resour. 2021;41:905–22.
23. Invernici MM, Salvador SL, Silva PHF, Soares MSM, Casarin R, Palioto DB, Souza SLS, et al. Effects of Bifidobacterium probiotic on the treatment of chronic periodontitis: A randomized clinical trial. J Clin Periodontol. 2018;45:1198–210.
24. Yoo J-I, Shin I-S, Jeon J-G, Yang Y-M, Kim J-G, Lee D-W. The effect of probiotics on halitosis: A systematic review and meta-analysis. Probiotics Antimicrob Proteins. 2017;11:150–7.
25. Rossoni RD, de Barros PP, de Alvarenga JA, Ribeiro FDC, Velloso MDS, Fuchs BB, et al. Antifungal activity of clinical Lactobacillus strains against Candida albicans biofilms: Identification of potential probiotic candidates to prevent oral candidiasis. Biofouling. 2018;34:212–25.
26. Modiri S, Heidari M, Shahmohammadi R, Jabbareh L, Maboudi A, Moosazadeh M, et al. A tangible prospect for the treatment of gingivitis using a potentially probiotic strain Lactobacillus plantarum MK06 isolated from traditional dairy products: A triple blind randomized clinical trial. BMC Oral Health. 2023;23:870.
27. Inchingolo F, Inchingolo AM, Malcangi G, De Leonardis N, Sardano R, Pezzolla C, de Ruvo E, et al. The benefits of probiotics on oral health: Systematic review of the literature. Pharmaceuticals. 2023;16:1313.
28. Guzel-Seydim ZB, Gökırmaklı Ç, Greene AK. A comparison of milk kefir and water kefir: Physical, chemical, microbiological and functional properties. Trends Food Sci Technol. 2021;113:42–53.
29. Kairey L, Leech B, El-Assaad F, Bugarcic A, Dawson D, Lauche R. The effects of kefir consumption on human health: A systematic review of randomized controlled trials. Nutr Rev. 2022;81:267–86.
30. Beattie RE. Probiotics for oral health: A critical evaluation of bacterial strains. Front Microbiol. 2024;15:1430810.
31. Squarzanti DF, Dell'Atti F, Scalia AC, Najmi Z, Cochis A, et al. Exploring the in vitro antibacterial potential of specific probiotic strains against oral pathogens. Microorganisms. 2024;12:441.
32. Krawczyk B, Wityk P, Gałęcka M, Michalik M. The many faces of Enterococcus spp.—Commensal, probiotic and opportunistic pathogen. Microorganisms. 2021;9:1900.
33. Saïz P, Taveira N, Alves R. Probiotics in oral health and disease: A systematic review. Appl Sci. 2021;11:8070.
34. Roselletti E, Sabbatini S, Ballet N, Perito S, Pericolini E, et al. Saccharomyces cerevisiae CNCM I-3856 as a new therapeutic agent against oropharyngeal candidiasis. Front Microbiol. 2019;10:1469.
35. Bourrie BCT, Richard C, Willing BP. Kefir in the prevention and treatment of obesity and metabolic disorders. Curr Nutr Rep. 2020;9:184–92.
36. Fiorda FA, de Melo Pereira GV, Thomaz-Soccol V, Rakshit SK, Pagnoncelli MGB, Vandenberghe LPDS, et al. Microbiological, biochemical, and functional aspects of sugary kefir fermentation—A review. Food Microbiol. 2017;66:86–95.
37. Gökırmaklı Ç, Güzel-Seydim ZB. Water kefir grains vs. milk kefir grains: Physical, microbial

and chemical comparison. J Appl Microbiol. 2022;132:4349–58.
38. Gamba RR, Yamamoto S, Abdel-Hamid M, Sasaki T, et al. Chemical, microbiological, and functional characterization of kefir produced from cow's milk and soy milk. Int J Microbiol. 2020;2020:7019286.
39. Aryana KJ, Olson DW. A 100-year review: Yogurt and other cultured dairy products. J Dairy Sci. 2017;100:9987–10013.
40. de Souza HF, Monteiro GF, Bogáz LT, Freire ENS, Pereira KN, Vieira de Carvalho M, et al. Bibliometric analysis of water kefir and milk kefir in probiotic foods from 2013 to 2022: A critical review of recent applications and prospects. Food Res Int. 2024;175:113716.
41. Plessas S, Nouska C, Mantzourani I, Kourkoutas Y, Alexopoulos A, Bezirtzoglou E, et al. Microbiological exploration of different types of kefir grains. Fermentation. 2016;3:1.
42. Hamida RS, Shami A, Ali MA, Almohawes ZN, Mohammed AE, Bin-Meferij MM, et al. Kefir: A protective dietary supplementation against viral infection. Biomed Pharmacother. 2021;133:110974.
43. Cogulu D, Topaloglu-Ak A, Caglar E, Sandalli N, Karagozlu C, Ersin N, et al. Potential effects of a multistrain probiotic-kefir on salivary Streptococcus mutans and Lactobacillus spp. J Dent Sci. 2010;5:144–9.
44. Reddy S, Madhu V, Punithavathy R, Satyam M, Chowdary UK, Mythraiye R, et al. Comparative evaluation of efficacy of kefir milk probiotic curd and probiotic drink on Streptococcus mutans in 8–12-year-old children: An in vivo study. Int J Clin Pediatr Dent. 2021;14:120–7.
45. Hasheminejad N, Malek Mohammadi T, Mahmoodi MR, Barkam M, Shahravan A, et al. The association between beverage consumption pattern and dental problems in Iranian adolescents: A cross sectional study. BMC Oral Health. 2020;20:74.
46. Şahin T, Akca G, Özmeriç N, et al. The role of probiotics for preventing dysbiosis in periodontal disease: A randomized controlled trial. Turk J Med Sci. 2024;54:357–65.
47. Lynch KM, Wilkinson S, Daenen L, Arendt EK, et al. An update on water kefir: Microbiology, composition and production. Int J Food Microbiol. 2021;345:109128.
48. Tzavaras D, Papadelli M, Ntaikou I, et al. From milk kefir to water kefir: Assessment of fermentation processes, microbial changes and evaluation of the produced beverages. Fermentation. 2022;8:135.
49. Cufaoglu G, Erdinc AN. An alternative source of probiotics: Water kefir. Food Front. 2023;4:21–31.
50. Maidana SD, Nicolás J, Albarracin L, Imamura Y, Arellano-Arriagada L, Namai F, et al. Modulation of the gut–lung axis by water kefir and kefiran and their impact on Toll-like receptor 3-mediated respiratory immunity. Biomolecules. 2024;14:1457.
51. Maidana SD, Moyano RO, Elean M, Imamura Y, Albarracín L, Namai F, et al. Modulation of the Toll-like receptor 3-mediated intestinal immune response by water kefir. Microbiol Res. 2024;15:1239–50.
52. Constantin EA, Popa-Tudor I, Matei F, Constantinescu-Aruxandei D, Oancea F, et al. Evaluation of polyphenol content and antioxidant activity of standard water kefir. Chem Proc. 2023;13:7.
53. Koh WY, Utra U, Ahmad R, Rather IA, Park Y-H, et al. Evaluation of probiotic potential and anti-hyperglycemic properties of a novel Lactobacillus strain isolated from water kefir grains. Food Sci Biotechnol. 2018;27:1369–76.
54. Premaraj TS, Vella R, Chung J, Lin Q, Panier H, Underwood K, et al. Ethnic variation of oral microbiota in children. Sci Rep. 2020;10:14788.
55. Samaranayake L, Matsubara VH. Normal oral flora and the oral ecosystem. Dent Clin North Am. 2017;61:199–215.
56. Lamont RJ, Koo H, Hajishengallis G. The oral microbiota: Dynamic communities and host interactions. Nat Rev Microbiol. 2018;16:745–59.
57. Pitts NB, Zero DT, Marsh PD, Ekstrand K, Weintraub JA, Ramos-Gomez F, et al. Dental caries. Nat Rev Dis Primers. 2017;3:17030.
58. Socransky SS, Haffajee AD, Cugini MA, Smith C, Kent RL. Microbial complexes in subgingival plaque. J Clin Periodontol. 1998;25:134–44.
59. Abu Fanas S, Brigi C, Varma SR, Desai V, Senok A, D'souza J, et al. The prevalence of novel periodontal pathogens and bacterial complexes in stage II generalized periodontitis based on 16S rRNA next generation sequencing. J Appl Oral Sci. 2021;29:e20200787.
60. Marsh PD, Zaura E. Dental biofilm: Ecological interactions in health and disease. J Clin Periodontol. 2017;44:S12–22.
61. Jakubovics NS, Goodman SD, Mashburn-Warren L, Stafford GP, Cieplik F, et al. The dental plaque biofilm matrix. Periodontol 2000. 2021;86:32–56.

62. Loos BG, Van Dyke TE. The role of inflammation and genetics in periodontal disease. Periodontol 2000. 2020;83:26–39.
63. Scannapieco FA, Gershovich E. The prevention of periodontal disease—An overview. Periodontol 2000. 2020;84:9–13.
64. Guo X, Cheng Y, Qiao Z, Xu J, Liang J, Zuo R, et al. Biological properties of S. Warneri KYS-164 isolated from kefir grains. J Agric Food Chem. 2024;72:25704–19.
65. Guo X, He Y, Cheng Y, Liang J, Xu P, He W, et al. The composition of Tibetan kefir grain TKG-Y and the antibacterial potential and milk fermentation ability of S. Warneri KYS-164 screened from TKG-Y. Food Funct. 2024;15:5026–40.
66. Mtampubolon M, Nurliza C, Abidin T, Gea S, Basri I, Gani A, et al. The assessment of probiotic to inhibition of glucosyltransferase enzyme of Streptococcus mutans ATCC25175. Int J Innov Sci Res Technol. 2022;7:654–8.
67. Radaic A, Kapila YL. The oralome and its dysbiosis: New insights into oral microbiome-host interactions. Comput Struct Biotechnol J. 2021;19:1335–60.
68. Van Dyke TE, Bartold PM, Reynolds EC. The nexus between periodontal inflammation and dysbiosis. Front Immunol. 2020;11:511.
69. Apalowo OE, Adegoye GA, Mbogori T, Kandiah J, Obuotor TM, et al. Nutritional characteristics, health impact, and applications of kefir. Foods. 2024;13:1026.
70. Nadelman P, Monteiro A, Balthazar CF, Silva HL, Cruz AG, Neves ADA, et al. Probiotic fermented sheep's milk containing Lactobacillus casei 01: Effects on enamel mineral loss and Streptococcus counts in a dental biofilm model. J Funct Foods. 2019;54:241–8.
71. de Lima MDSF, da Silva RA, da Silva MF, da Silva PAB, Costa RMPB, Teixeira JAC, et al. Brazilian kefir-fermented sheep's milk, a source of antimicrobial and antioxidant peptides. Probiotics Antimicrob Proteins. 2018;10:446–55.
72. Egea MBD, Santos DCD, Oliveira Filho JGD, Ores JdC, Takeuchi KP, Lemes AC, et al. A review of nondairy kefir products: Their characteristics and potential human health benefits. Crit Rev Food Sci Nutr. 2020;62:1536–52.
73. Chuang L-C, Huang C-S, Ou-Yang L-W, Lin S-Y, et al. Probiotic Lactobacillus paracasei effect on cariogenic bacterial flora. Clin Oral Investig. 2010;15:471–6.
74. Piwat S, Pahumunto N, Srisommai P, Mapaisansin C, Teanpaisan R, et al. Effect of probiotic delivery vehicles for probiotic Lactobacillus rhamnosus SD11 in caries prevention: A clinical study. J Food Process Preserv. 2019;43:e14147.
75. Zhang Y, Ding Y, Guo Q, et al. Probiotic species in the management of periodontal diseases: An overview. Front Cell Infect Microbiol. 2022;12:806463.
76. Hamet MF, Medrano M, Pérez PF, Abraham AG, et al. Oral administration of kefiran exerts a bifidogenic effect on BALB/c mice intestinal microbiota. Benef Microbes. 2016;7:237–46.
77. Bessa MK, Bessa GR, Bonamigo RR, et al. Kefir as a therapeutic agent in clinical research: A scoping review. Nutr Res Rev. 2023;37:79–95.
78. Tom FS, Tucker KJ, McCracken CM, McGregor JC, Gore SJ, et al. Infectious complications of probiotic use: A matched case–control study. Infect Control Hosp Epidemiol. 2021;43:1498–500.
79. Gupta VK, Rajendraprasad S, Ozkan M, Ramachandran D, Ahmad S, et al. Safety, feasibility, and impact on the gut microbiome of kefir administration in critically ill adults. BMC Med. 2024;22:80.
80. Moslemi D, Latifi S, Mehdizadeh M, et al. Kefir probiotic products on the count of Candida albicans in saliva of chemotherapy patients: A randomized placebo-controlled single-blind study. Casp J Intern Med. 2025;16:90–5.
81. Navidifar T, Mahdizade Ari M, Alipourkermani A, Afifirad R, Asadollahi P, Veisi A, et al. Clinical efficacy of probiotics on oral health: A systematic review of clinical trials. Curr Pharm Biotechnol. 2023;24:1916–27.