

Original Article: Chewing gum improves oral health



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ABSTRACT

Gum has been used to clean the mouth and refresh the breath for millennia. The first medicinal chewing gum was presented to the market in 1928. The European Pharmacopoeia classified medicated chewing gum's intended use as local therapy of oral illnesses or systemic administration following absorption through the buccal mucosa or gastrointestinal tract in 1991. Bacteria, viruses, fungi, and protozoa live in the mouth cavity, which is home to a complex microbiota. Sugar-free gum (SFG) chewing might be a low-cost complement to existing caries prevention methods for 532 million youngsters. The current review highlighted the chewing gum effects on oral health.

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Introduction

According to the World Health Organization (WHO), oral illness affects half of the world's population. Caries of the primary dentition and untreated dental caries afflict 2.4 billion people worldwide. Oral healthcare costs are significant, accounting for around 5% of total health spending in high-income nations, while oral health needs remain unfulfilled in most low- and middle-income countries (1).

Oral microbes are a known contributor to the development of dental caries. Therefore, in addition to lowering sugar consumption, preventive strategies might target these microorganisms.

Streptococcus mutans (SM) (facultatively anaerobic, gram-positive) is one microorganism implicated in the caries process, and its presence is linked to the acceleration of the disease (2, 3). Sugar-free gum (SFG) chewing might be a low-cost complement to existing caries prevention methods for 532 million youngsters.

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The mouth cavity has a number of characteristics that make it a unique home for a variety of microorganisms. Most of the time, the oral cavity's surfaces are constantly soaked in saliva, at a specific temperature range (34–36°C) and pH near to neutral (4).

Diverse kinds of microflora are discovered to be spread in various ecological niches in such an ideal environment (5). In general, the mouth contains at least six billion bacteria, representing over 700 different species (6), as well as other microbes like as mycoplasma, fungus, protozoa, and maybe even viruses (7). Oral bacteria can be divided into Gram-positive and Gram-negative bacteria, as well as anaerobic and facultatively anaerobic bacteria based on their oxygen needs (4).

Regular toothbrushing, mouth rinses, dental floss, or other interdental cleaning devices are all important in maintaining oral health. Gum chewing has also been suggested as a supplement to good dental hygiene (8).

For the aforementioned goals, a large number of chewing gum products containing active substances such as enzymes, hydrogen peroxide, sorbitol fluoride, chlorhexidine xylitol, zirconium silicate, sodium bicarbonate, and zinc acetate are offered (9).

Probiotic bacteria, according to the World Health Organization, are living microorganisms that, when given in sufficient proportions, provide a health benefit to the host (10). Although the exact mechanisms of action are unknown, the general consensus is that relatively innocuous microbes compete with infections and exert health-promoting and therapeutic effects locally and systemically via affecting the immune system (11-13).

A gingival infection is characterised by significant leukocyte infiltration and inflammatory exudation in the marginal region and is caused by a combination of Gram-positive and Gram-negative bacteria (14).

Malodorous chemicals can be formed in the oral cavity by a mixture of anaerobic bacteria, food leftovers, exfoliated epithelial cells, and salivary proteins that collect in the tongue's fissures. As a result, a link between malodour and the quantity of tongue coating has been established (15-17).

Oral malodour as measured by organoleptic scores may benefit from probiotic chewing gums (18). Probiotic bacteria have raised notice in the dental community as a supplementary method of preventing illnesses caused by oral microbial flora (19). Gums are water soluble, nonstarch, polysaccharides obtained from plants (both land and sea) or produced by microbial fermentation (20).

Chewing gum history, development and the role in oral health

People have chewed on many materials throughout history in order to freshen their breath or treat mouth dryness. Early chewing gums were made from tree resins. Thomas Adams was not able to effectively distribute chewing gum on a large scale until 1870 (21, 22). For more than two decades, gums have been utilized as a stabilizing element in dairy products.

Gums, as polyhydroxy compounds, may bind and retain water to create a gel, making them helpful as gelling and thickening agents in dairy foods such as yoghurt, cheese, milk, and ice cream to increase viscosity, texture, and organoleptic properties (23).

Gums have also been used to help probiotic bacteria flourish (24). Chewing gum has been known for its role in maintaining and improving oral health as a result of serving various consumer demands (21).

Chewing gums now contain a number of basic components. Gum base is often made up of a blend of elastomers such as polyvinylacetate or polyisobutylene, as well as softeners, emulsifiers, and plasticizers. Approximately 70% of all gums produced include sugar replacements such as xylitol, sorbitol, erythritol, mannitol, and/or maltitol instead of traditional sweeteners like sucrose, and are thus classified as "sugar-free" gums.

The most significant advancement in moving chewing gum from a candy to a nutraceutical with particular oral health advantages was the substitution of traditional sugars with sugar-free gums. Many of the benefits of chewing gum on dental health are based on increased salivation and the mechanical action of mastication so cause: reduction in oral dryness,

food debris removal, calculus formation inhibition, extrinsic tooth stain inhibition, reduction of volatile sulfur compounds, biofilm pH neutralization, enamel remineralization, oral biofilm development reduction and influence on biofilm composition (25).

Lactobacillus reuteri and chewing gum

Monocytes and mast cells release the anti-inflammatory cytokine IL-10, which is hypothesized to suppress the production of cytokines produced by Th-1 cells (26). Although its effect in gingival inflammation is poorly understood, this cytokine is considered an important immune-regulator in the intestinal tract (27).

Although the mechanism of probiotic activity in the oral cavity is unknown, it is typically explained by a combination of local and systemic immunomodulation, as well as non-immunologic defensive mechanisms (28). *Lactobacillus reuteri* chewing gums dramatically lower the levels of inflammatory cytokines TNF- α and IL-8, which may help to explain the mechanism of probiotic activity in the oral cavity. *Lactobacillus reuteri* is a helpful and commensal microbe found in the mouth cavity and gastrointestinal system of mammals. A *Lactobacillus reuteri* strain has previously been shown to have a strong inhibitory impact on TNF- α expression by human monocytes and macrophages (29).

Moreover, *Lactobacillus reuteri* is thought to generate an unidentified immunomodulin that inhibits TNF- α production by LPS-activated monocytoïd cells (30). It's also been suggested that the antibacterial chemical reuterin, which *Lactobacillus reuteri* produces from glycerol, may have a role in *Lactobacillus reuteri*'s probiotic activities (31).

However, recent research has revealed that reuterin is very sensitive to a wide range of gut microorganisms (32, 33). The lowering of pro-inflammatory cytokines in gingival crevicular fluid (GCF) might represent proof of concept for chewing gums containing the probiotic *Lactobacillus reuteri* in fighting oral inflammation (34).

When examined by organoleptic ratings, daily usage of chewing gums containing probiotic lactobacilli had a minor but statistically

significant positive effect on oral malodour in young adults. As a result, probiotic bacteria might be used as a supplement to better oral hygiene and antibacterial rinses for the treatment of oral malodour (18).

As a result, the use of benign, commensal probiotics might provide a better long-term therapy method for foul breath. Although persistent colonisation is uncommon in adults, probiotic bacteria can thrive in saliva and compete for binding sites in the dental biofilm (35).

The immunological response of the host may be influenced by probiotic bacteria consumption. More research is needed to confirm and understand the mechanisms of probiotic bacteria's influence on salivary immunity (36). Also, according to a recent study, the inclusion of gums in milk drinks might serve as a functional component to improve the viability and levels of b-galactosidase activity of *Lactobacillus*, so helping to alleviate lactose malabsorption.

Streptococcus mutans and chewing gum

Tooth caries is an infectious illness that starts with the acid generated by bacteria in the dental plaque metabolism. Tooth decay is thought to be a microbial infection produced by numerous different kinds of bacteria in the mouth. *Streptococcus mutans*, one of the most frequent bacteria implicated in dental caries, is capable of creating a huge quantity of acid and is extremely resistant to acidic circumstances (37, 38).

To limit the activity of these bacteria, many techniques have been proposed, including the use of toothpastes, antibacterial substances (e.g. chlorhexidine), fluoride-containing mouthwashes, and non-fermentable sweeteners such as xylitol. (39, 40).

Xylitol, a five-carbon sugar alcohol, is found in a variety of fruits and vegetables (although in small amounts). It's a common sweetener in sugar-free foods, particularly chewing gums, as well as several mouthwashes and toothpastes. (41, 42). Xylitol has been shown to help prevent dental caries by lowering dental plaque and restricting salivary *S. mutans* numbers and lactic acid production. (41).

After a brief duration of use, 15 percent xylitol caused a drop in mutans streptococci (MS) salivary levels that lasted beyond the stoppage.

(43). Furthermore, as compared to herbal and placebo chewing gums, chewing 100 percent Xylitol sweetened chewing gum four times a day for 10 minutes each time for 21 days can dramatically lower salivary *S. mutans* counts, which may be effective in managing dental caries among risk patients (44).

Ghasemi and colleagues found that xylitol-containing chewing gums and probiotic yogurt are equally efficient in lowering salivary *S. mutans* counts on the first, second, and fourth weeks following the intervention. As a result, long-term usage is advised as a safe and effective caries prevention strategy. (45).

Stevia, a natural sweetener with antibacterial and antifungal properties, has been utilized in diabetic patients. Vandana and colleagues found that using a 10.6% stevioside mouth rinse for six months has strong antiplaque and antigingivitis characteristics (46). In another investigation, stevia-containing chewing gum was shown to be as beneficial as Xylitol chewing gum in lowering salivary *S. mutans* levels (47).

Chitosan has been found to be beneficial in lowering enamel decalcification and caries as a consequence of reduced bacterial activity in a variety of products, including gums, dentifrices, and toothpastes. (48-50). According to a study, chitosan-based chewing gum has a good effect on the decrease of salivary *S. mutans* colonies but has no significant influence on salivary pH rise (38).

The fruit extract of *Phyllanthus emblica* (PE) possesses pharmacological action and has antibacterial, antioxidative, anti-inflammatory, and anti-cancer properties. An experiment on twenty healthy young people revealed that the PE fruit gum group had substantially greater salivary flow rates and pH levels after 0–2, 2–5, and 5–10 minutes of chewing than the other groups.

At 75–80 minutes, there were significant differences in total bacteria, *S. mutans*, *P. gingivalis*, and volatile sulfur compounds (VSC) levels between the PE and control gum groups. There were no reported side effects. Chewing gum with PE fruit extract enhanced salivary flow and dramatically lowered clinical test indices in the short term, hence, PE gum chewing might be a safe way to improve dental hygiene.(51).

Magnolia bark extract (MBE) is a natural anti-inflammatory, antiplatelet, and chemopreventive substance. The active ingredients in MBE, magnolol and honokiol, are both hydrophobic and come from the *Magnolia officinalis* tree. (8). The ethanolic extract of *Magnolia officinalis* exhibits the most bactericidal activity against *Streptococcus mutans* and *Streptococcus sobrinus*. (52). In vitro, these components inhibited the growth of *Streptococcus mutans*, *Streptococcus sobrinus*, *Fusobacterium nucleatum*, *Porphyromonas gingivalis*, *Aggregatibacter actinomycetemcomitans*, *Capnocytophaga gingivalis*, and *Veillonella dispar*, and in an animal experiment, they reduced dental caries values (53, 54).

Magnolia bark extract was previously used in a xylitol-based chewing gum. 30-day usage of a chewing gum containing magnolia tree extract demonstrated significant effects on oral health, including reduced salivary mutans streptococci, plaque acidogenicity, and bleeding on probing specific oral bacterial strains, according to a randomized controlled intervention experiment (55).

Recent research looked at the effects of MBE on self-perceived breath freshness in 10 human volunteers who chewed gum with and without MBE added as a functional food. They also looked at the effects of MBE on cell-surface hydrophobicity and bactericidal effects in human saliva after exposing oral bacteria to it. Instead of a bactericidal process, MBE gum promotes self-perceived breath freshness. This is likely due to a rise in Gram-negative bacteria cell-surface hydrophobicity (8).

Conclusion

Medicinal chewing gum suggested to have controlling effects on *Streptococcus mutans*, which shows itself by varied saliva flow and Ph and in upper step by preventing the dental caries. Further studies required to demonstrating more beneficial effects of chewing gum and utilizing it as routine oral health caring agent among children and adults.

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