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Chewing Gum and Teeth Investigating the Effects on Dental Plaque, Saliva pH, Oral Hygiene and Insights into Dental Health Improvement.

***Srishti Sudhakar*[1]**

[1]*GEMS Modern Academy, Dubai (United Arab Emirates)*

ABSTRACT:

The objective of the present study was to investigate the effects of different types of chewing gum on dental health, focusing on dental plaque, saliva pH, and overall oral hygiene and to evaluate its potential role as a supplementary approach to traditional dental care. The methodology involved analyzing the formation of dental caries through acid dissolution of tooth minerals by microbial activity, detailing the demineralization by organic acids produced by microorganisms and remineralization by saliva components (Anil, Ibraheem, Meshni, Preethanath, & Anil, 2022), and reviewing postprandial changes in saliva pH (Vedantu, n.d.). Major findings indicated that a reduction in saliva pH below 5.5 contributes to demineralization. Chewing gum, particularly sugar-free types, stimulates saliva flow, which aids in buffering acid levels. Additionally, the presence of polyols like xylitol and sorbitol enhances its anti-cariogenic potential (Roquette, n.d.; World Health Organization, 2017). These insights suggest that sugar-free chewing gum may serve as a practical, low-cost adjunct to conventional oral hygiene practices, contributing to improved oral health outcomes on a broader scale.

Keywords: Chewing gum, sorbitol, xylitol, plaque, dental caries, saliva pH.

I. Introduction

Dental caries are one of the most common diseases affecting people all around the world. The World Health Organization classified it as one of the major public health problems worldwide (World Health Organization, 2025). However, dental caries can be prevented if appropriately and timely diagnosed. Dental caries are formed when the mineral tissue of teeth is dissolved by acid produced by microbes. It involves the demineralization by organic acids originated from microorganisms and remineralization by saliva components (Anil, Ibraheem, Meshni, Preethanath, & Anil, 2022). A reduction of pH of saliva below 5.5 is associated with demineralization. After every meal, a decrease in saliva pH is observed (Vedantu, n.d.). To overcome this decrease in pH of saliva, certain substances have been introduced to increase the saliva pH. One such substance is chewing gum. Chewing gum stimulates saliva production, and sugar-free chewing gum has an anti-cariogenic effect on teeth as well, due to the stimulation of saliva production and the presence of polyols like xylitol and sorbitol in the gum (Roquette, n.d.; World Health Organization, 2017). Chewing gum is available in the sugar-containing form and sugar-free form. Chewing on sugar-free gum considerably minimizes the risk of tooth decay (Hayes, 2001). Chewing gum with artificial sweeteners like xylitol and sorbitol has shown to have oral benefits (Mäkinen, 2010). It has also been shown that sorbitol-sweetened chewing gum has a low cariogenicity when it is chewed thrice a day (Soderling & Pienihäkkinen, 2020). Xylitol-sweetened gum was non-cariogenic in all the protocols tested (Scheinin & Mäkinen, 1975). Xylitol-sweetened gum also plays a role in the transmission of bacterial infections like streptococci between mothers and children (Soderling & Pienihäkkinen, 2020). In general conditions, saliva takes an hour or more to replace minerals lost; chewing gum can speed up this process while washing away food particles and other debris from the mouth (Mäkinen, 2010). Chewing on gum has several benefits, including fresher breath, plaque prevention, and saliva stimulation. When talking about the freshening of breath aspect, chewing gum has added flavors like spearmint and peppermint, which aid in temporarily combating bad breath (The Dental Group, 2024). Chewing gum helps dislodge food particles and bacteria from teeth, reducing the build-up of plaque and lowering the risks of tooth decay and gum disease (Nature, 2015). With regards to saliva stimulation, chewing gum stimulates the production of saliva, which is necessary for maintaining good oral health. Saliva helps in the neutralization of acids in the mouth, washes away food particles and bacteria, and also remineralizes the tooth enamel (Dentistry Today, 2004). Sugar-free chewing gum can provide oral health benefits such as increased saliva flow, plaque prevention, and fresh breath in moderation (Oral Health Foundation, n.d.; Smiles Care, 2024). Notwithstanding this, excessive gum chewing or choosing sugary options can have drawbacks, including potential jaw strain and increased risk for tooth decay (Paradigm Dental, 2024).

II. Material and Methodology

Dental plaque contains bacteria, leftover food particles, and saliva. When consuming food, the bacteria in the mouth feed on the food debris and break it down into an adhesive and acidic film of plaque (Cleveland Clinic, 2025; Wikipedia, 2025). When plaque is not removed, it can cause cavities, periodontal diseases, and other oral health issues (Fresh Mouths, 2025). Tooth plaque contains bacteria, leftover food particles, and saliva. Plaque is colorless, but sometimes, it can cause discoloration of the teeth because food particles adhere to the plaque (WebMD, 2025; Cleveland Clinic, 2025; Avance Dental, 2025). Tartar is hardened plaque. When plaque is not regularly removed, it will turn into tartar, which cannot be brushed or flossed away; only a dentist or hygienist is equipped to remove it. Tartar is also called dental calculus. Tartar may be an off-white or yellowish color initially, but over time, it can stain the color of the food consumed. Coffee, tea, and tobacco, for example, can stain tartar to a darker color (Cleveland Clinic, 2025; Perfect Dental, 2025; WebMD, 2024). Plaque is formed when bacteria in the mouth react with sugary or starchy food like milk, juice, soda, bread, pasta, and fruit. The bacteria present release acids that disintegrate carbohydrates in food and drinks (Cleveland Clinic, 2025; FoodDrinkTalk, 2024; Animated Teeth, 2025). When teeth are not brushed soon after eating or drinking, the combination of bacteria, acids, and carbohydrates can combine to form a sticky, colorless film called plaque (Cleveland Clinic, 2025; Peace Haven Family Dentistry, 2023; Compass Dental Group, 2023).

When regular brushing and flossing is not done, plaque can harden into tartar, which only a dental professional can remove. Extreme dental plaque and tartar can lead to cavities, gingivitis, other periodontal diseases, abscessed teeth, and tooth loss (Cleveland Clinic, 2025; Royal Dental Care, 2025; WebMD, 2025).

Dental caries are not severe diseases but can cause economic loss, pain, and suffering. The inability to chew food, bad breath, and lesions in the tooth are breeding grounds for bacteria that weaken the body and lead to other diseases (WHO, 2025). Dental caries affect people of all ages. Lack of knowledge about dental caries prevention and incorrect oral health care attitudes can lead to not receiving proper treatment (CDC, n.d.). Dental cavities are caused by the tooth, time, bacteria, and time of tooth surface acid exposure (WHO, 2017).

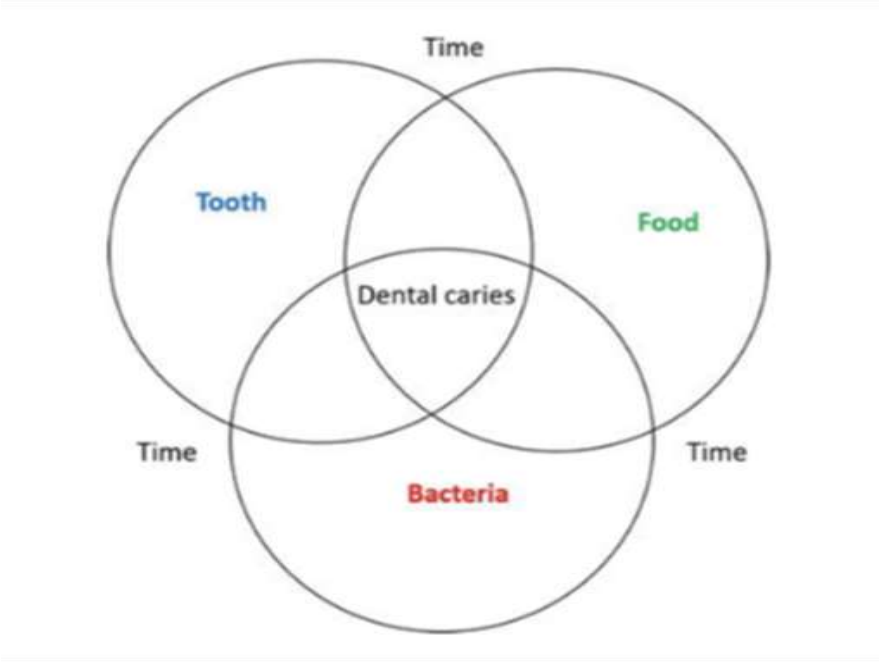

Figure. 1 (Phuphaniat, 2023)

Dental caries or tooth decay occurs when bacteria in the mouth produce acids that attack and corrode the tooth enamel. This leads to the formation of a hole in the teeth, known as caries or cavities (American Dental Association, 2023; World Health Organization, 2020). If tooth decay is not treated, it can lead to pain, infection, and even tooth loss (Levine & Stillman-Lowe, 2019). When decay-causing bacteria come in contact with sugar and starch from food and drinks, they form an acid. This acid attacks the tooth's enamel, causing it to lose minerals (National Institute of Dental and Craniofacial Research, 2025; Animated Teeth, 2025). On repeated exposure to acid, the tooth enamel continues to lose minerals, and a white spot may appear where minerals have been lost (National Institute of Dental and Craniofacial Research, 2025). Tooth decay and mineral loss can be combatted and reversed. Enamel can repair itself using minerals from saliva and fluoride from toothpaste, or through application of fluoride by a dentist (National Institute of Dental and Craniofacial Research, 2025; Dentaly, 2024; Wakim, 2025). If more minerals are lost than what can be restored, then the enamel is weakened. It breaks down and forms a cavity (Dentaly, 2024; WebMD, 2024; Arkansas Family Dental, 2025).

Saliva not only plays the crucial role of lubricating the tongue, but also plays a major role in preventing dental caries. Saliva helps in neutralizing the enamel-corroding acid released by the bacteria (Malik et al., 2025). Saliva breaks down food particles and reduces the risk of tooth decay. Saliva supplies minerals that help repair early damage to the teeth and strengthen the tooth enamel. It is observed after every meal that there is a decrease in the pH of saliva, leading to demineralization of tooth enamel due to acids.

To overcome the decrease in the pH of saliva and eventual demineralization of the enamel, certain substances are introduced. These substances, when chewed, increase the pH of saliva to a safe level (Enax et al., 2024). Several food items regulate the salivary flow rate and affect the acidogenicity of saliva, like some medicines, acidic candy, toffees, etc. While toffees, lozenges, and certain candy stimulate salivary flow, they have a more destructive effect due to their high sugar content and sticky nature (VenkateshBabu et al., 2020). More recently, however, chewing gum has been gaining a large liking among children.

Saliva that is at a balanced pH level from 6.2 to 7.6 helps maintain a healthy mouth and protects teeth as well (Healthline, 2025). The food and drinks consumed can change the pH level of saliva. Bacteria in the mouth break down the consumed carbohydrates, releasing lactic acid, butyric acid, and aspartic acid, effectively lowering the pH of saliva (St. Lawrence Dentistry, 2022). Age also plays a role in affecting the pH of saliva; adults tend to have more acidic saliva than children (DiFoggio & Hannan, 2023).

The mouth needs a balanced pH. The pH level of saliva can drop below 5.5 when consuming acidic beverages, causing acids in the mouth to demineralize the tooth enamel (Healthline, 2025). When the tooth enamel gets too thin, the dentin of the tooth is exposed, leading to discomfort and sensitivity when consuming hot or cold food (St. Lawrence Dentistry, 2022; DiFoggio & Hannan, 2023).

Usually, chewing gum contains high levels of sugars, favoring the demineralization process (Giacaman, Umaña, & Nuñez, 2023). Chewing gums stimulate the production of saliva, increasing its buffering action (Stookey, 2008). To overcome the negative effects of sugars in chewing gums, sugar-free gums were introduced to negate the effect of fermentable carbohydrates in the sugar-containing gums (Nuca & Amariei, 2015). Sugar (sucrose) containing gums must be avoided because they are less stimulatory to salivary flow than sugar-free gums. Sugar-containing gums do not promote mineralization but have a cariogenic and demineralizing effect due to the continued release of sucrose (Giacaman et al., 2023).

It has been experimentally observed that chewing sugar-free gum can help in reducing and even preventing tooth decay (Phuphaniat, 2023). Saliva produced on chewing sugar-free gum can stimulate saliva production, which reduces sensitivity of teeth and plays a crucial role in oral hygiene (BiologyInsights Team, 2025). Gum sweetened with xylitol has more decay-fighting benefits than gum sweetened with sorbitol. With sorbitol, some acidic waste byproducts are still produced, and cavity-forming bacteria can still digest sorbitol; however, they cannot do the same with xylitol (Casey, 2024). This makes xylitol a fundamental ingredient for chewing gum meant to combat gingivitis (Phuphaniat, 2023).

Xylitol has immense oral benefits, which have been officially accepted by both the United States Food and Drug Administration and the European Union (European Food Safety Authority, 2011; U.S. Food and Drug Administration, 2018). Xylitol is not as cheap as sucrose and sorbitol, and it cannot be used in cooked food products because it is destroyed by heat. Its use is restricted to products that require only small amounts of sweetener, like chewing gum (Mäkinen, 2010).

Sorbitol is a polyol, which is a standard substitute for sugar not only in sugar-free chewing gums but also in over-the-counter medicines (Mäkinen, 2010). Sorbitol is 60% as sweet as sucrose and is cheaper than xylitol. Its lower costs make it appealing to food manufacturers; however, it is less effective than xylitol in controlling tooth decay and cavities (Söderling & Pienihäkkinen, 2020; Giacaman, Umaña, & Nuñez, 2023).

Xylitol is a natural sweetener derived from fibrous parts of plants. It is a polyol and does not break down like normal sugar (DiFoggio, n.d.). Xylitol is a key ingredient of chewing gum because it prevents bacteria from adhering to the teeth, protecting the tooth from decay while maintaining a neutral pH level in the mouth (Ontario Dental Hygienists' Association, 2016). Cavity-causing bacteria in the mouth cannot digest xylitol; as a result, their growth is significantly reduced. Consequently, acid cannot be formed by the bacteria, leading to a common pH between the plaque and saliva (BiologyInsights Team, 2025). Xylitol can help repair damage to the enamel. Saliva which has xylitol in it is more alkaline than saliva stimulated by other sugar-based products (Dunne, 2024). After chewing gum with xylitol present in it, the concentration of amino acids, ammonia in saliva and plaque, and the pH of plaque rises (Smile Store, n.d.). When pH is above a certain level, calcium and phosphate salts in saliva start to move into weakened parts of the enamel, beginning the process of hardening them up again (Bow Lane Dental, n.d.). Xylitol has immense oral benefits which have been officially accepted by both the United States Food and Drug Administration and the European Union (Dunne, 2024). It is estimated that to prevent dental caries with the use of xylitol, it is not necessary to replace sucrose in the diet, and it has been shown that relatively small doses of xylitol can provide anticaries protection (Wu et al., 2022). It has been stipulated that chewing gum sweetened with xylitol from three to five times a day, for a minimum of 5 minutes after food intake, is effective to achieve the desired effect on cariogenic bacteria (Nayak et al., 2014; Gerger, 2008). Xylitol is considered cariostatic since it diminishes the counts of Streptococcus mutans (SM), the formation of dental plaque, and therefore dental caries incidence (Söderling & Pienihäkkinen, 2021). It is particularly effective in conditions under which it is not possible to commit to proper oral hygiene. Its method of action is to create an unfavorable environment for the growth of bacteria like SM, as it reduces their ability to adhere to oral tissues by affecting the insoluble glucans involved in this process (Loimaranta et al., 2020). This property reduces the possibility of forming dental plaque and therefore the local effect of lactic acid. Xylitol penetrates the bacterial cytoplasm, interfering with glycolysis and inhibiting the growth of microorganisms. Other species affected include Streptococcus sobrinus (SS), Lactobacillus (LB), and Actinomyces viscosus (AV). As a result, a less cariogenic environment is created (Hanno et al., 2012).

Like xylitol, sorbitol causes a decrease in SM, SS, AV, and LB and insoluble glucans, with an elevation of salivary pH, which gives it an anticariogenic potential (Söderling & Pienihäkkinen, 2021). Current evidence established that polyols like xylitol and sorbitol had good results in reducing dental caries. However, xylitol is more effective, so it is more commonly used (Mickenautsch & Leal, 2007). A study conducted in 2009 compared the variations of salivary pH using both sorbitol and xylitol and concluded that xylitol significantly reduces acidogenicity in dental plaque; this effect was not observed with sorbitol (Mäkinen, 2010).

III. Result

A long-term permanent solution to halitosis does not exist. In addition to sugar-free gum, a non-alcoholic mouthwash and strong toothpaste can be used to eliminate bad breath (Nunes, 2018). Steps like brushing twice a day and flossing after brushing, cleaning the tongue, eating healthy food, and staying hydrated are crucial steps to combating halitosis (Varley & Abbas, 2024). Chewing sugar-free gum is recommended to combat bad breath, although not as the only solution to bad breath (Gurarie, 2024).

Chewing sugar-free gum is an important preventative oral health behavior. Chewing sugar-free gum increases salivary pH and thus assists in mineralization (Nuca & Amariei, 2015). The presence of polyols like xylitol and sorbitol in chewing gum improves the oral health benefits obtained by regularly chewing gum (Sri et al., 2023). Such polyols cannot be fermented and can directly inhibit the formation of plaque (Nasseripour et al., 2022). Sugar-containing gums do not promote mineralization but can be directly cariogenic through sustained release of sucrose (Sri et al., 2023).

When talking about the overall effect of chewing gum on health, we understand that chewing gum helps in stress relief, boosts memory, and supports digestive health (HealthSpectra, 2018). Sugar-containing gum has a negative effect on the teeth as compared to sugar-free gum because the sugar present in the chewing gum harbors bacteria, which in turn causes decay of the teeth. Sugar-free gum, like those containing xylitol or sorbitol, freshens breath and improves dental health as well. Dental cavities can be avoided by managing microorganisms on the tooth responsible for demineralization. Chewing gum possesses adhesive properties. It promotes saliva flow, aids in eliminating food particles, and reduces the formation of biofilms on oral cavities. This reduces the risk of caries (Phuphaniat, 2023). Sugar-free chewing gum containing substances like xylitol has antibacterial and remineralization properties as well (Cocco et al., 2020). Sugar-free gum has the ability to remove food particles and tartar, stimulate saliva formation, increase oral pH, inhibit demineralization of enamel, and increase remineralization. All these properties help in preventing dental cavities (Anil et al., 2022).

Chewing gum can also have several pitfalls. These include dental work risks and jaw strain (Cleveland Clinic, 2022). Prolonged chewing can pose a strain on the muscles of the jaw joint and muscles; this can lead to temporomandibular joint disorders in certain individuals as well (All About TMJ, 2024; Kneib Dentistry, 2024).

Thus, it is crucial to chew gum in moderation and be mindful of any signs of jaw discomfort (Cleveland Clinic, 2022). For individuals with dental restorations like fillings, crowns, or bridges, excessive chewing of gum can increase the risk of dislodging and damaging these restorations (Kneib Dentistry, 2024; All About TMJ, 2024).

Although chewing gum can reduce plaque accumulation in predilection sites of dental caries, it has little to no effect on the predilection sites for gingivitis, even though there have been reductions in the gingival index (Söderling & Pienihäkkinen, 2021; Forghani, 2020; Hattab, 2023).

IV. Discussion

Sugar-free gums are characterized by their ability to maintain a pH above 5.7 within and after 30 minutes of consumption (Phuphaniat, 2023). Several studies have concluded that these sugar-free gums have an anticariogenic effect, which is mainly due to the stimulation of saliva through chewing, remineralization promotion, mechanical control of bacterial plaque, replacement of sugar sweeteners harmful to bacteria, and incorporation of therapeutic agents (Yeung et al., 2023; Dentistry.co.uk, 2014). These properties make sugar-free gum a valuable adjunct in dental cavity prevention (World of Dentistry, n.d.). The increased salivary flow is associated with an increase in anticariogenic potential, because it is related to a rise in the pH, which reduces the acidogenic effect of the bacterial plaque and improves the remineralization potential of the enamel (Enax et al., 2024). This has been observed in clinical trials where greater remineralization of caries lesions has been observed under the same circumstances (Rusu et al., 2022). It is also proven that an increase in the salivary flow rate contributes majorly to oral health. Despite some articles confirming an increase in salivary flow when chewing gum, a study pointed out that in older adults that regularly chew gum, it does not increase stimulated saliva flow in these patients (Aguirre-Zero et al., 1993).

A few minutes after sugar intake, the dental plaque pH decreases, leading the enamel to demineralize when the acidity level is under the critical pH, which varies among individuals (Swaroop, 2024). At this point, acids affect the enamel by dissolving apatite crystals and releasing calcium and phosphate ions in the saliva (Zabokova Bilbilova, 2020). Despite this process taking place naturally, it leads to the deterioration of the enamel over time. The remineralization process happens when there is an oversaturation of ions in the oral environment, and they incorporate calcium, phosphate, and other minerals in decalcified tooth areas since they look for balance on the enamel surface. This way, minerals added to gum can improve the tooth remineralization process and have proved to be an effective mechanism for preventing the progression of enamel decay (Anil et al., 2022).

Maintaining effective control of bacterial plaque is the cornerstone of all preventative measures for caries and periodontal disease, and this is one of the actions of chewing gum. Due to its sticky surface, the mechanical forces produced during chewing and the increase in salivary flow remove a certain amount of plaque from the more exposed teeth surfaces (Van der Weijden & Slot, 2011; Tonetti & Jepsen, 2014). This was seen in a study which compared the plaque rate before and after chewing sugar-free gum and reported approximately 44% less plaque after consuming gum (Van Loveren & Duggal, 2003). At present, there is a wide variety of sweeteners which replace sugar in chewing gum. These products are non-cariogenic as they make bacterial metabolism more difficult and prevent the production of acids because they are not fermentable (Jayadevan et al., 2019). Also, their anticariogenic potential is increased because of the provocation of palatability reflection due to the sweet taste, which together with the chewing process increases stimulation of saliva flow (Zhu et al., 2021; Van Loveren & Duggal, 2003).

V. Conclusion

Sugar-free chewing gum—particularly formulations containing xylitol—serves as an effective adjunct to traditional oral hygiene by stimulating saliva flow, elevating salivary pH above the demineralization threshold, and mechanically disrupting plaque biofilms, thereby reducing the incidence of dental caries (Anil et al., 2022; Söderling & Pienihäkkinen, 2021) . While sugar-containing gums may exacerbate demineralization through sustained sucrose release, sugar-free alternatives not only mitigate cariogenic risk but also confer additional benefits such as halitosis control and enamel remineralization (Mäkinen, 2010; World Health Organization, 2017) . Nonetheless, moderation is advised to avoid potential jaw strain and to preserve the integrity of dental restorations. Overall, incorporating sugar-free chewing gum into daily oral care routines offers a low-cost, non-invasive strategy to enhance dental health across populations.

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