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Original article

EFFECT OF XYLITOL ON PLAQUE INDEX AND ACIDITY OF DENTAL BIOFILM AND SALIVA

Ralitsa Bogovska-Gigova, Krasimir Hristov
Department of Pediatric Dentistry, Faculty of Dental Medicine, Medical University, Sofia, Bulgaria.

SUMMARY

Introduction: Dental caries is the most common oral disease in childhood, and sucrose plays a significant role in its development. As awareness grows of the health implications surrounding high sugar diets, finding appropriate sugar substitutes becomes crucial. One of the used substitutes is xylitol - a sugar alcohol used as a sweetener. The aim of this study was to evaluate and compare the effects of using xylitol lollipops in children aged 7 to 12 years on the formation and accumulation of dental biofilm, the pH value of dental biofilm, and the pH value of saliva.

Materials and methods: The study involved 40 children aged 7 to 12. The value of the plaque index, the pH of the saliva, and plaque were evaluated after 14-day frequent usage of xylitol lollipops.

Results: The results show that the use of xylitol lollipops reduces the values of the plaque index. Xylitol products have been shown to potentially increase plaque and saliva pH values. The differences are statistically significant compared to the baseline levels ($p<0.001$).

Conclusion: These findings collectively suggest that xylitol effectively reduces plaque accumulation and maintains a favorable pH environment in the oral cavity, which can help prevent dental caries and improve overall oral health. Such products are a valuable preventive measure among schoolchildren and can replace the use of sugar-containing lollipops.

Keywords: preventive measures, xylitol, xylitol lollipops, pH of dental biofilm, pH of saliva,

INTRODUCTION

Dental caries is a serious health problem, affecting between 60 and 90% of children between 7 and 12 years of age, as well as adults [1]. It is the most common oral disease in childhood, and dental biofilm is identified as a significant risk factor for its development [2]. The etiology of the disease is associated with a disruption of homeostasis in the oral microbiome due to a decrease in its pH with frequent intake of simple carbohydrates in the diet [3]. As a result, conditions are created to develop the disease process [3]. Despite the preventive care applied, the prevalence of dental caries worldwide continues to be significant. At the end of the last century, the scientific dental community became interested in using sugar alcohols as substitutes for sugars to prevent dental caries. Sugar alcohols (or polyols) are organic compounds with a sweet taste. The most commonly used sugar alcohols in the food industry are maltitol, lactitol, sorbitol, mannitol, erythritol, and xylitol [4].

Xylitol is a 5-carbon sugar alcohol with a crystalline structure found in many fruits and plants [5]. It achieves the same sweetness as sucrose without causing physiological insulin production by the body because the small intestine does not absorb it. This is why xylitol is widely used in many diabetic food products and in chewing gums, syrups, lozenges, sprays, mouthwashes, gels, toothpaste, candies, and varnishes [6, 7]. In various tests, sugar alcohols are non- or hypoacidogenic and, therefore, have a low cariogenic potential [8]. Xylitol has the property of inhibiting the growth of oral streptococci [9]. It cannot be used for energy production by mutans streptococci. Instead, S. mutans metabolizes it to xylitol-5-phosphate, suppressing glucose's normal metabolism to lactate (the primary plaque acid) by inhibiting glycolytic enzymes. This leads to reduced acid production in plaque and a reduced number of cariogenic microorganisms with lower plaque index values. Additionally, S. mutans enters a cycle of energy loss [9]. Several studies have analyzed the impact of xylitol on oral health, prevention of dental caries, plaque control, and other risk factors and have proven its positive effects [7]. There is a lot of scientifically based evidence in the literature on the effectiveness of xylitol products on oral health and the possibility of their use to prevent caries in childhood [7, 9]. At the same time, no studies have investigated the impact of xylitol lollipop consumption in children on the pH values of dental biofilm, saliva, and plaque index.

PURPOSE

The study **aim**ed to assess the caries-protective effect of xylitol lollipops in children aged 7 to 12. To realize this aim, two tasks were assigned:

- to evaluate and compare the effects of using xylitol lollipops in children aged 7 to 12 years on the formation and accumulation of dental biofilm, the pH value of dental biofilm, and the pH value of saliva;
- to study the dynamics of changes in the pH values †of supragingival plaque in children one hour after using a xylitol lollipop.

MATERIALS AND METHODS

The study involved 40 children aged 7 to 12 who visited the clinical practice halls of students and clinical private practices of residents in the Department of Pediatric Dentistry, Faculty of Dentistry, Medical University—Sofia. Written informed consent for the participation in the clinical study was obtained from their parents. Approval from the Ethics Committee of the Medical University of Sofia was also obtained (No. 2296/28.06.2023).

Criteria for inclusion of children in the study:

- Children aged 7 to 12 years with moderate or high caries risk;
- Children whose parents/guardians have signed an informed consent to participate in this project;
- Children without common diseases;
- Children who have agreed to follow hygiene and nutritional recommendations during the study period;
- Children who have not undergone antibiotic or corticosteroid treatment for at least 1 month before or during the study.

Oral examination: The first oral examination selected suitable volunteer participants for the study. Each child underwent an oral examination by a Pediatric Dentistry specialist according to the standard protocol with directed light, drying, and an oral examination kit (mirror, probe, and tweezers). Dental status was recorded, and the condition of the oral mucosa, gingiva, tongue, and frenulums was assessed. The status data were recorded on a specially prepared card, and carious lesions were classified according to the International Caries Detection and Assessment System – ICDAS II. ICDAS II code 1 was used as the diagnostic threshold. A DMFT index was calculated for each child, and a caries risk assessment was made using a form approved by the Department of Pediatric Dentistry-Sofia. The data were recorded in the patient's medical record. For the purposes of the study, only patients with moderate and high caries risk were selected.

The plaque index (according to Silness and Loe), saliva pH, and plaque pH values were calculated for all children studied. The baseline values †were recorded in the patient's chart. At the end of the first visit, professional oral hygiene was performed with prophy cups (Pro-Cup™ Junior Prophylaxis, Kerr, Switzerland) and polishing paste (Cleanic Kerr, Schwitzerland). All children were given the same toothbrushes (Elmex Junior, GABA GmbH, Therwil, Switzerland) and toothpaste (Elmex Junior, GABA GmbH). Recommendations were also made for maintaining a proper nutritional and oral hygiene regimen during the study (Tables 1 and 2).

Table 1. Nutritional guidelines during the study.

Nutriotional guidelines
- The daily diet should include three main meals and no more than two snacks;
- Sweet foods (containing sugar) should be eaten as a dessert during main meals, not between them;
- The daily menu should include fruits, vegetables, and dairy products;
- Limit the constant snacking of carbohydrate foods and sweet drinks;
- Minimize your daily intake of sweet and sticky foods and pastries (cereals, chips, pretzels, wafers, etc.). Be aware that pretzels, chips, pretzels, snacks, etc., are also foods that increase caries risk;
- Limit the daily intake of sweetened fruit juices, carbonated drinks, and sweetened tea. They should be eaten during the main meals;
- Swallow the food after chewing it and do not hold it in the mouth;
- Ensure the intake of foods that protect teeth from developing cavities. These include fresh vegetables, dairy products, fish, and meat.

Table 2. Rules for individual oral hygiene during the study.

Rules for personal oral hygiene
- Oral hygiene must be carried out in the evening, before going to bed, and in the morning after waking up;
- Teeth should be cleaned with a children's toothbrush and fluoride toothpaste (the ones that were given to the child before the start of the study) every morning and evening;
- The time for brushing teeth should be 2-3 minutes and controlled with a watch.

Conducting the study: The study was conducted in 2 stages as follows:

- Stage 1 – control, lasting 14 days – the children did not receive any additional instructions and prophylactic products other than standard oral hygiene and dietary measures;
- Stage 2, lasting 14 days – the children used xylitol lollipops XyliPOP (Miradent, Hager & Werken GmbH & Co. KG, Duisburg, Germany) once a day. XyliPOP (Miradent) lollipops are officially registered and allowed

for use in Bulgaria as food with registration number 54482/09.06.2020 with the importer and official representative Chimtrade-Komet Ltd.

In each stage, the child visited the dental office three times – on the 1st, 7th, and 14th day. The control examinations to evaluate the parameters were conducted in the morning between 8-11 am to avoid the effects of circadian rhythms. The children were instructed to refrain from consuming food and drinks (except water) for at least one hour before the visit and not to brush their teeth in the morning on the corresponding day of the visit to the dentist. The control for implementing the above recommendations was assigned to the parents of the children.

The distribution of the stages of the study and the regimen of use of the studied products is presented in Table 3.

Table 3. Distribution of children by stages and the regimen of intake of the studied products.

Stage	Number	Product	Regimen of intake
1	**40**	**Control**	No prophylactic product intake. Standard oral hygiene and dietary measures (tab. 1, tab. 2)
2	**40**	**Xylitol lollipops**	The lollipops are used once a day for 14 days – in the morning, after regular oral hygiene.

Methodology for recording and assessing plaque index: To establish the child's oral hygiene status, the Silness and Loe plaque index was used. It assesses the thickness of the plaque in the cervical zone of the tooth (closest to the gum). The vestibular surfaces of all fully erupted maxillary incisors and canines (primary or permanent) were examined. Each representative tooth was examined for plaque visually and scraped with a probe on the cervical third of its vestibular surface. Data were recorded using the codes presented in Table 4.

Table 4. Codes for assessing plaque accumulation.

0 - No plaque on scraping;
1 - Presence of a small amount of plaque on the free gingival margin and around it on the vestibular surface. Plaque is visible after scraping with a probe;
2 - Moderate accumulation of plaque on the free gingival margin and around it on the vestibular surface, visible even without scraping;
3 - Abundance of plaque in the gingival sulcus on the free gingival margin and around it on the vestibular surface.

The plaque index was recorded several times:

- At the first stage (control) - on the first, seventh, and 14th day and
- At the second stage - on the first, seventh, and 14th day.

Methodology for collecting saliva samples for determining saliva pH: Parents and children were instructed to refrain from consuming food and drinks (except water) 1 hour before the test and from oral hygiene in the morning on the day of sample collection. A specially developed product of the company GC - Saliva-Check Buffer (GC Saliva-Check Buffer, GC Corporation, Tokyo, Japan), which is used as a routine test of saliva characteristics in a dental office, was used for this test. The test was used according to the manufacturer's instructions.

- Children rinsed with water and then spitted the saliva in a sterile measuring cup. Litmus paper, which was included in the kit, was used to measure the pH value of the collected saliva. The pH value of the collected saliva in each stage of the study was examined as follows:
- At the first stage (control) - on the first, seventh, and 14th day;
- At the second stage - on the first, seventh, and 14th day.

Methodology for assessing the pH of the dental biofilm: The pH level of the supragingival dental plaque of the children was monitored. The collection of the dental plaque was carried out using a sterile probe by scraping in the area of †the gingival third of the vestibular surface of the molars. The amount of plaque was with the size of the head of a pinhead (1 mg). It was dissolved in 2 ml of distilled water in a small sterile Eppendorf tube using a vortex mixer Biosan V-1 plus (Biosan, Riga, Latvia) at 3000 RPM for 30 seconds. The pH value of the plaque was measured using a digital pH meter (Oakon pHTestr 50S Spear-Tip Waterproof Pocket tester, Premium 50 Series). The pH value of the collected plaque was examined at each stage of the study as follows:

- At the first stage (control) - on the first, seventh, and 14th day;
- At the second stage - on the first, seventh, and 14th day.

All results were documented in the individual card for each child and subjected to statistical analysis to prove reliability.

Methodology for recording the change in plaque pH value after taking a xylitol lollipop – second task of the study

The study was conducted in three visits, once every week, 2 months after the end of the study on the first task, to avoid accumulation of the effect. The same 40 children from the first task of the study participated in it. The study aimed to monitor supragingival plaque pH value †changes after taking a xylitol lollipop (Table 5).

Table 5. Distribution of stages and children in the second task of the study.

Visit	Number	Product	Intervention
1	40	Control No intake	The supragingival pH value of each participant was measured at baseline and at the 15th, 30th and 60th minute without medication intake.
2	40	Xylitol lollipops	Baseline supragingival plaque pH was measured, then again 15, 30, and 60 minutes after ingestion of the xylitol lollipop
3	40	Children rinse with a 10% sucrose solution for 1 min.	Baseline supragingival plaque pH was measured, then again 15, 30, and 60 minutes after ingestion of the sugar solution

The collection of plaque and the assessment of its pH were carried out according to the previously described methodology.

Statistical methods: Statistical analysis was conducted using statistics computer software SPSS v.19.0 (SPSS Inc., Chicago, IL, USA). The significance level was set at $p = 0.05$. The differences between the groups were analyzed using nonparametric tests because the normality assumption could not be met (Shapiro-Wilk test, $p < 0.05$).

RESULTS

The distribution of children according to their age, gender, caries risk, and DMF index is shown in the following table. The data shows that the distribution by gender and age does not have statistically significant differences. Most of the children studied are at high risk of developing caries, and only 15% are at moderate risk. The average DMFT index in children of both genders is about 3.

Table 6. Distribution of the studied children by gender, age, and caries risk.

Gender											
Boys						**Girls**					
n		%				n		%			
18		45%				22		55%			
χ^2 test=0.400, p=0.527											
Age											
7 years		**8 years**		**9 years**		**10 years**		**11 years**		**12 years**	
n	%	n	%	n	%	n	%	n	%	n	%
4	10%	8	20%	6	15%	9	22.5%	9	22.5%	4	10%
χ^2 test=4.100, p=0.535											
Caries risk											
Moderate						**High**					
n		%				n		%			
6		15%				34		85%			
χ^2 test=19.600, p<0.001											
Mean DMFT index											
Boys						Girls					
Mean ± SD						Mean ± SD					
3.17 ± 2.14						2.95 ± 1.46					
Oneway ANOVA test: p=0.713											

The baseline data of the values of the plaque index, saliva pH, and plaque pH are presented in the following table.

Table 7. Baseline data – first stage of the study.

Time / Factor	1 day (1) Mean ± SD	7 day (2) Mean ± SD	14 day (3) Mean ± SD	Paired Samples test
Plaque index (Silness-Loe)	2.19 ± 0.75	2.06 ± 0.72	2.12 ± 0.77	$T_{1,2}$=1.76, p=0.09 $T_{2,3}$=0.732, p=0.44 $T_{1,3}$=-0.757, p=0.52
pH saliva (litmus paper)	6.87 ± 0.25	6.81 ± 0.50	6.80 ± 0.31	$T_{1,2}$=-0.621, p=0.53 $T_{2,3}$=-1.841, p=0.06 $T_{1,3}$=-0.133, p=0.89
pH plaque (pH meter)	6.91 ± 0.36	6.92 ± 0.42	6.88 ± 0.41	$T_{1,2}$=-0.082, p=0.93 $T_{2,3}$=0.362, p=0.71 $T_{1,3}$=0.485, p=0.63

The baseline data on the Silness and Loe plaque index show that children generally have poor oral hygiene and high mean values (from 2.06 to 2.19) of the plaque index. The salivary pH values are neutral but close to the borderline with acidic saliva, from 6.80 to 6.87. These data are expected, given that 85% of the children in the study are at high caries risk. Statistically significant differences were not found during the first stage of the study.

Table 8 shows the impact of using xylitol lollipops on oral health of children aged 7 to 12 years for 14 days and compares the data with the baseline.

Table 8. Effect of xylitol lollipops on plaque index, salivary pH, and plaque pH.

Time / Factor	1 day Mean ± SD	7 day Mean ± SD	14 day Mean ± SD
Plaque index (SL)			
Baseline	2.19 ± 0.75	2.06 ± 0.72	2.12 ± 0.77
Xylitol lollipop	1.89 ± 0.42	1.65 ± 0.48	1.49 ± 0.46
Paired Samples test	T=2.12, p=0.04	T=3.05, p<0.001	T=5.01, p<0.001
pH of saliva			
Baseline	6.87 ± 0.25	6.81 ± 0.50	6.80 ± 0.31
Xylitol lollipop	6.91 ± 0.26	7.06 ± 0.34	7.05 ± 0.34
Paired Samples test	T=-0.66, p=0.50	T=-0.01, p<0.001	T=-3.08, p<0.001
pH of plaque			
Baseline	6.91 ± 0.36	6.92 ± 0.42	6.88 ± 0.41
Xylitol lollipop	6.92 ± 0.34	7.01 ± 0.44	7.13 ± 0.37
Paired Samples test	T=-0.117, p=0.90	T=-0.85, p=0.39	T=-2.88, p<0.001

The results show a decrease in plaque index after 14 days of xylitol use. The decrease showed statistically significant differences compared to the baseline level (p<0.001). Saliva pH values †increased minimally to a mean level of 7.06 and remained at these values †after 2 weeks of xylitol lollipop use. Plaque pH increased to 7.13, with the differences being statistically significant (p<0.001).

Table 9 presents the data from the immediate effect of plaque pH directly after taking a xylitol lollipop and sugar syrup after 15, 30, and 60 minutes.

Table 9. Change in plaque pH after the intake of xylitol and sugar syrup.

Time / Group	Baseline -1 Mean ± SD	After 15 min -2 Mean ± SD	After 30 min -3 Mean ± SD	After 60 min -4 Mean ± SD	T-test
Control (5)	6.92 ± 0.55	6.91 ± 0.60	6.92 ± 0.39	6.90 ± 0.44	p<0.001
Xylitol lollipop (6)	7.01 ± 0.44	7.08 ± 0.39	7.07 ± 0.14	7.05 ± 0.17	$T_{1,2}$=-0.69, p=0.48 $T_{1,3}$=0.903, p=0.37 $T_{1,4}$=-0.545, p=0.58
Control – sugar syrup (7)	6.87 ± 0.68	5.36 ± 0.56	5.74 ± 0.34	6.38 ± 0.41	$T_{1,2}$=-4.56, p= p<0.001 $T_{1,3}$=-3.96, p= p<0.001 $T_{1,4}$=-1.94, p=0.05
T test	$T_{5,6}$=-0.17, p=0.85 $T_{5,7}$=-0.16, p=0.87 $T_{6,7}$=-0.00, p=0.99	$T_{5,6}$=-0.86, p=0.38 $T_{5,7}$=-5.24, p= p<0.001 $T_{6,7}$=-4.83, p= p<0.001	$T_{5,6}$=-1.04, p=0.29 $T_{5,7}$=-3.85, p= p<0.001 $T_{6,7}$=-3.58, p= p<0.001	$T_{5,6}$=-2.99, p= p<0.001 $T_{5,7}$=-4.43, p= p<0.001 $T_{6,7}$=-1.67, p=0.09	

We assessed plaque pH 15, 30, and 60 minutes after consuming the xylitol lollipop. We did not find any change in plaque pH using the xylitol lollipop. Plaque pH remained above seven after 15, 30, and 60 minutes after consuming the xylitol lollipop (Table 9). There was no risk of plaque pH falling below the critical value of 5.5 using the xylitol lollipop.

DISCUSSION

The study evaluated and compared the in vivo effects of xylitol lollipops on the Silness and Loe plaque index and the pH of saliva and plaque. Xylitol is a natural polyol sweetener shown to have specific and beneficial effects on oral health [10]. Regular consumption of xylitol has been suggested to reduce the occurrence of carious lesions [11]. Some authors have suggested that xylitol acts as an oral prebiotic, reducing the levels of mutans streptococci and thus may increase the resistance of microorganisms to dysbiosis [12]. Other authors believe that the plaque of individuals who consume xylitol is less adhesive due to a decrease in the number of streptococci and, accordingly, reduced amounts of extracellular polysaccharides in the plaque [7]. Some studies have reported that xylitol consumption is associated with a reduced amount of dental plaque [13], while others reject this claim [14]. Most of the studies with xylitol showing a reduction in dental plaque and a lower plaque index have been conducted with chewing gum or candy [15]. Our study shows that the use of xylitol lollipops also reduced the values of the plaque index, with the differences being statistically significant compared to patients who did not use xylitol products (p<0.001).

A study in Kuwait included individuals aged 10 to 27 years who consumed xylitol candies thrice daily for 18 months [15]. The authors found that the mean plaque index of the study participants decreased statistically significantly from 1.73 to 1.14 [15]. Other authors followed the dynamics of changes in salivary and plaque pH values after consuming xylitol chewing gum and found an increase in the values of both factors. The salivary pH value increased from 5.99 to 6.61 one hour after the consumption of xylitol chewing gum, and the increase in plaque pH value over the same period was from 5.33 to 5.91, which is above the critical value of 5.5 [16]. In our study, we did not find a momentary change in plaque pH immediately after the consumption of the lollipop (Table 9). The effect of xylitol is likely to be cumulative with regular use. In general, the participants in our study did not have low plaque and salivary acidity at the beginning, which is probably the reason for the lower increase in the indices. However, the trend reported by other authors for a favorable effect on the monitored indicators – salivary pH and dental biofilm – was observed.

One study monitored the change in salivary pH values in young children aged 3 to 6 years after consuming xylitol lollipops [17]. The authors found that xylitol lollipops could significantly increase salivary pH to values of 7.57 compared to the control group (without lollipop use), where the reported average value was pH=6.06 [17]. Xylitol seems to stimulate salivary flow, which naturally causes an increase in the buffering capacity and protective properties of saliva [17]. Hegde and Thakkar also concluded that xylitol significantly improves the physicochemical properties of saliva [18].

Our results are consistent with those of other authors [19]. Xylitol products are a good way to maintain oral health. They have been shown to have the potential to increase plaque and saliva pH and reduce plaque accumulation (Table 8). This may also lead to a reduction in caries activity among children [19].

Chavan et al. focused on the effects of xylitol-containing chewing gums on the number of S. mutans in saliva [20]. They concluded that 100% xylitol-sweetened gum, when chewed four times a day for 10 minutes each time for 21 days, can significantly reduce the number of S. mutans in saliva, which may be beneficial for controlling dental caries among high risk patients [20].

Few studies investigate the effect of xylitol consumption on the number of microorganisms in dental plaque [21, 22]. Plaque bacteria cannot ferment xylitol as they can other sugars, such as sucrose or glucose. In addition, xylitol increases the concentration of ammonia and amino acids. It reduces lactic acid production in plaque, thereby neutralizing plaque acids and promoting neutral conditions in the oral cavity [22]. Xylitol can also induce the production of salivary enzymes, which can lead to inhibition of the growth of bacteria in dental plaque [23]. This action, in turn, leads to a lower level of plaque accumulation, which is also confirmed by our data (Table 7).

The present study found that consuming lollipops with xylitol reduced the plaque index while increasing salivary and plaque pH (Table 8). The use of such products is a useful preventive measure among schoolchildren and can replace the use of sugar-containing lollipops. Despite the obvious advantages they possess, their consumption should not be without restrictions due to their pronounced erosive potential [24], as well as the fact that plaque pH values decrease in the first 60 minutes after their use, albeit slightly (Table 9). This is especially important in individuals whose diet includes frequent snacks and intake of simple carbohydrates. The use of lollipops (especially with the perception that they are beneficial for the oral environment) in such patients creates both an extremely high risk of developing caries and a risk of developing erosive defects.

CONCLUSION

Xylitol lollipops can potentially reduce the Silness and Loe plaque index and increase the pH values of dental biofilm and saliva above the critical ones for demineralization. This provides us with scientifically based evidence for the effectiveness of children's use of these products and grounds for recommending them as reasonable and appropriate means for preventing caries in childhood.

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REFERENCES:

1. Aggarwal C, Sandhu M, Sachdev V, Dayal G, Prabhu N, Issrani R. Prevalence of dental caries and dental fluorosis among 7-12-year-old school children in an Indian subpopulation: A cross-sectional study. *Pesqui Bras Odontopediatria Clín Integr.* 2021; 21:e0141:1–9. [Crossref]

2. Ray RR. Dental biofilm: Risks, diagnostics and management. *Biocatal Agric Biotechnol.* 2022 Aug; 43:102381. [Crossref]

3. Proctor DM, Shelef KM, Gonzalez A, Davis CL, Dethlefsen L, Burns AR, et al. Microbial biogeography and ecology of the mouth and implications for periodontal diseases. *Periodontol 2000.* 2020 Feb; 82(1):26-41. [PubMed]

4. Riley P, Moore D, Ahmed F, Sharif MO, Worthington HV. Xylitol-containing products for preventing dental caries in children and adults. *Cochrane Database Syst Rev.* 2015 Mar 26;2015(3):CD010743. [PubMed]

5. Ahuja V, Macho M, Ewe D, Singh M, Saha S, Saurav K. Biological and Pharmacological Potential of Xylitol: A Molecular Insight of Unique Metabolism. *Foods*. 2020 Nov 2;9(11):1592. [PubMed]

6. Wölnerhanssen BK, Meyer-Gerspach AC, Beglinger C, Islam MS. Metabolic effects of the natural sweeteners xylitol and erythritol: A comprehensive review. *Crit Rev Food Sci Nutr.* 2020;60(12):1986-1998. [PubMed]

7. Kõljalg S, Smidt I, Chakrabarti A, Bosscher D, Mändar R. Exploration of singular and synergistic effect of xylitol and erythritol on causative agents of dental caries. *Sci Rep*. 2020;10(1):6297. [PubMed]

8. Seki M, Karakama F, Kawato T, Tanaka H, Saeki Y, Yamashita Y. Effect of xylitol gum on the level of oral mutans streptococci of preschoolers: block-randomized trial. *Int Dent J*. 2011;61(5):274-280. [PubMed]

9. Miyasawa H, Iwami Y, Mayanagi H, Takahashi N. Xylitol inhibition of anaerobic acid production by Streptococcus mutans at various pH levels. *Oral Microbiol Immunol.* 2003 Aug;18(4):215-9. [PubMed]

10. Salli K, Lehtinen MJ, Tiihonen K, Ouwehand AC. Xylitol's Health Benefits beyond Dental Health: A Comprehensive Review. *Nutrients.* 2019 Aug 6;11(8):1813. [PubMed]

11. Desphande A, Jadad AR. The impact of polyol-containing chewing gums on dental caries: a systematic review of original randomized controlled trials and observational studies. *J Am Dent Assoc.* 2008;139:1602–1614. [PubMed]

12. Söderling E, Pienihäkkinen K. Effects of xylitol and erythritol consumption on mutans streptococci and the oral microbiota: a systematic review. *Acta Odontol Scand.* 2020;78:599–608. [PubMed]

13. Latifi-Xhemajli B. Effectiveness of xylitol toothpaste in caries

prevention: a review article. *Georgian Med News.* 2024 Sep;(354):32-35. [PubMed]

14. van Loveren C. Sugar alcohols: what is the evidence for caries-preventive and caries-therapeutic effects? *Caries Res.* 2004 May-Jun; 38:286-93. [PubMed]

15. Shyama M, Honkala E, Honkala S, Al-Mutawa SA. Effect of xylitol candies on plaque and gingival indices in physically disabled school pupils. *J Clin Dent.* 2006;17(1):17-21. [PubMed]

16. Kumar S, Sogi SH, Indushekar KR. Comparative evaluation of the effects of xylitol and sugar-free chewing gums on salivary and dental plaque pH in children. *J Indian Soc Pedod Prev Dent* 2013 Oct-Dec; 31(4):240-4. [PubMed]

17. Jain S, Mathur S. Estimating the effectiveness of lollipops containing xylitol and erythritol on salivary pH in 3-6 years olds: A randomized controlled trial. *J Indian Soc Pedod Prev Dent.* 2022 Jan-Mar;40(1):19-22. [PubMed]

18. Hegde RJ, Thakkar JB. Comparative evaluation of the effects of casein phosphopeptide amorphous calcium phosphate (CPP ACP) and xylitol containing chewing gum on salivary flow rate, pH and buffering capacity in children: An in vivo study. *J Indian Soc Pedod Prev Dent.* 2017 Oct-Dec;35(4):332-337. [PubMed]

19. Muralikrishnan K, Asokan S, Priya PR. Effect of different chewing gums on dental plaque pH, salivary pH, and buffering capacity in children: A randomized controlled trial. *SRM J Res Dent Sci.* 2018 Oct-Dec;9(4):158-63. [Crossref]

20. Chavan S, Lakashminarayan N, Kemparaj U. Effect of Chewing Xylitol Containing and Herbal Chewing Gums on Salivary Mutans Streptococcus Count among School Children. *Int J Prev Med.* 2015 May 22;6:44. [PubMed]

21. Syed M, Chopra R, Shrivastava V, Sachdev V. Comparative evaluation of 0.2% chlorhexidine mouthwash, xylitol chewing gum, and combination of 0.2% chlorhexidine mouthwash and xylitol chewing gum on salivary Streptococcus mutans and biofilm levels in 8 to 12yearold children. *Int J Clin Pediatr Dent.* 2016 Oct-Dec;9(4):313-319. [PubMed]

22. Elmokanen MA, Ezzat MA, Ibrahim AH, Shaalan OO. Effect of dissolving xylitol chewable tablets versus xylitol chewing gum on bacterial count and salivary pH in geriatric bedridden patients: A randomized clinical trial. *J Int Oral Health.* 2022 Jan-Feb;14(1):1725. [Crossref]

23. Mitrakul K, Srisatjaluk R, Vongsawan K, Teerawongpairoj C, Choongphong N, Panich T, et al. Effects of shortterm use of xylitol chewing gum and moltitol oral spray on salivary Streptococcus mutans and oral plaque. *Southeast Asian J Trop Med Public Health.* 2017 Mar; 48(2):485-93. [PubMed]

24. Bogovska-Gigova R, Hristov K, Gateva N, Pencheva-El Tibi I. Evaluation of pH and Acidity in Xylitol Lollipops, Propolis Mouthwash, and Probiotic Lozenges: An in Vitro Study. *Int J Sci Res (IJSR).* 2024 May;13(5):1791-1795. [Crossref]

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Address of correspondence:
Ralitsa Bogovska-Gigova
Department of Pediatric Dentistry, Faculty of Dental Medicine, Medical University – Sofia;
1, Georgi Sofiisky Str., Sofia, Bulgaria.
E-mail: r.bogovska@fdm.mu-sofia.bg