EFFECTIVENESS OF CHEWING GUM AND TOOTHPASTE OF XYLITOL ON THE PLAQUE INDEX IN THE ADOLESCENT GROUP *(EFEKTIVITAS PERMEN KARET DAN PASTA GIGI XYLITOL TERHADAP INDEKS PLAK PADA KELOMPOK REMAJA)*

Henri Hartman[1*], Andi Supriatna[2], Badi Soerachman[3], Raina Azzah Maliha[1]
[1]Department of Pediatric Dentistry, Universitas Jenderal Achmad Yani Cimahi Indonesia
[2]Department of Public Health, Universitas Jenderal Achmad Yani Cimahi Indonesia
[3]Department of Conservative Dentistry, Universitas Jenderal Achmad Yani Cimahi Indonesia

*Corresponding author
henri.hartman@lecture.unjani.ac.id

JHDS.unjani.ac.id/jite
Doi: 10.54052/jhds.

Article History
Received:07/01/22
Accepted: 07/02/22

ABSTRACT

Periodontal disease and caries are part of dental and oral health problems. The main cause of periodontal disease and caries is plaque. Dental plaque can be controlled with a combination of chemicals and mechanics treatment. The growth of dental plaque can be inhibited by using chemicals, namely xylitol which can be used in the form of chewing gum or toothpaste. Xylitol is a natural carbohydrate sweetener that cannot be fermented by bacteria in the oral cavity. Xylitol can accumulate *Streptococcus mutans* intracellularly and make *Streptococcus mutans* expends energy to break down accumulated xylitol without producing unfavorable energy. This research was conducted as literature study and analyzed the findings obtained. This literature review used six pieces of literature about xylitol chewing gum and two pieces of literature about xylitol toothpaste. Data analysis used Paired Samples T-Test of plaque index. The results showed that there

was a statistically significant result (p<0,05) of the plaque index before and after using xylitol chewing gum. On the other hand, there was no significant result (p>0,05) on the plaque index before and after using xylitol toothpaste. The decreased plaque index was established in both of the xylitol types, but not meaningful when used in toothpaste.
Keywords: chewing gum; toothpaste; xylitol

ABSTRAK

Penyakit periodontal dan karies merupakan salah satu masalah kesehatan gigi dan mulut. Penyebab utama penyakit periodontal dan karies adalah plak. Cara mengendalikan plak gigi dapat dilakukan dengan kombinasi bahan kimia dan mekanik. Kontrol plak kimia menggunakan bahan kimia yang mengandung kontrol plak. Pertumbuhan plak dapat dihambat dengan menggunakan bahan kimia yaitu xylitol yang dapat berupa permen karet dan pasta gigi. Xylitol adalah pemanis karbohidrat alami yang tidak dapat difermentasi oleh bakteri di rongga mulut. Xylitol dapat mengakumulasi Streptococcus mutans secara intraseluler dan membuat Streptococcus mutans mengeluarkan energi untuk memecah xylitol yang terakumulasi tanpa menghasilkan energi lainnya yang merugikan. Penelitian ini dilakukan dengan studi kepustakaan sebagai referensi dan menganalisis temuan yang diperoleh. Sampel yang digunakan adalah enam buah literatur yang terdiri dari permen karet xylitol dan dua buah literatur yang terdiri dari pasta gigi xylitol. Analisis data menggunakan Paired Samples T-Test. Hasil penelitian diperoleh bahwa terdapa perbedaan yang signifikan antara sebelum dan sesudah menggunakan permen karet xylitol (p<0,05) sedangkan untuk pasta gigi xylitol tidak terdapat perbedaan yang signifikan (p>0,05). Penurunan indeks plak terjadi dalam dua jenis bahan tersebut, namun penggunaan xylitol pada pasta gigi tidak memberikan penurunan yang berarti.
Kata kunci : *permen karet; pasta gigi; xylitol*

INTRODUCTION

Health is a part of the most important factors in human life, including dental and oral health.[1] The Global Burden

Of Disease Study (2017) contained 3.5 billion cases of oral conditions with 2.3 billion having untreated caries in the permanent teeth, 767 million having periodontal disease, and 532 million having untreated caries in the primary teeth.[2] According to the World Health Organization (WHO), dental and oral hygiene and gingival problems often occur at the age of 12-15 years old.[3] Based on the Indonesian Basic Health Research results in 2018, adolescents aged 15-19 years who have a habit of consuming sweet foods more than once per day are 41%, while adolescents aged 15-19 years who consume sweet drinks more than once per day are 56.43%.[4]

Sweet foods are classified as cariogenic foods that can cause a decrease in the pH of dental plaque and can increase the rate of growth of dental plaque.[5,6] Plaque that accumulates around the teeth continuously can cause periodontal disease and caries.[7] Dental plaque is a microbial biofilm formed by a microorganism consisting of an extracellular matrix of host polymer and bacteria which is a structured, grayish-yellow substance on the surface of intraoral hard tissues.[8,9] Plaque prevention efforts can be carried out by controlling plaque with mechanical methods and chemical methods. Chemicals that can inhibit plaque growth, namely xylitol, can be in the form of chewing gum, toothpaste, and mouthwash.[10]

Xylitol is a natural carbohydrate sweetener that cannot be broken down by bacteria in the oral cavity. Xylitol can interfere with bacterial energy production, causing bacterial cell death and reducing the potential for bacterial acid production.[11] Xylitol can be produced as chewing gum and toothpaste which is effective in inhibiting the growth of *Streptococcus mutants* and reducing the amount of dental plaque. Consuming xylitol 5-10 grams per day is still considered within safe limits.[12] The brands of xylitol chewing gum on the market are CariFree, Xylimax Spry peppermint xylitol chewing gum and Miradent xylitol chewing gum.[13] Toothpaste brands that contain xylitol on the market are Xyliwhite, Epic, and Spry.[13,14]

METHOD

The research was conducted from September 2021 to December 2021 using Software, Journals, and databases, to summarize these sequences. This research was descriptive to know the effectiveness of xylitol chewing gum and xylitol toothpaste. The research by conducting a literature study on several libraries used as a reference and analyzing the findings obtained. Using six pieces of literature on xylitol chewing

gum and two pieces of literature on xylitol toothpaste. Using a google search engine on the internet with keywords: xylitol chewing gum, xylitol toothpaste, dental plaque. The database was taken from reputable articles published by Pubmed, ReseachGate, ScienceDirect, and Google Scholar. The research is based on determining the research theme by formulating the problems found in the literature community. The choices of literature are based on matches in the research theme. The search of the literature was found by PubMed, Sciencedirect, ResearchGate, and Google Scholar. It was following predetermined themes from various sources according to the inclusion and exclusion criteria. Data analysis was obtained from the results of literature analysis following the results of the descriptive analysis method and carried out statistical tests with the t-test method with statistical applications.

RESULT

Based on the literature analysis, there were six-piece literature on xylitol chewing gum and two pieces of literature about xylitol toothpaste. Based on kinds of literature on xylitol chewing gum. The research was undertaken by Sumantri in 2013 with 56 samples 12-15 years old. The index plaque value before treatment with xylitol chewing gum is 1,212 and after treatment with xylitol chewing gum was 0,631 with the difference between before and after treatment was 0,58.[15]

Saheer *et al* in 2019 with 12 samples 14-15 years old. The index plaque value before treatment with xylitol chewing gum was 2,75 and after treatment with xylitol chewing gum was 2,24 with the difference between before and after treatment was 0,51.[16]

Xiu-juan Li *et al* in 2010 with 10 samples with age 13-15 years old. The index plaque value before treatment with xylitol chewing gum was 2,396 and after treatment with xylitol chewing gum was 1,005 with the difference between before and after treatment was 1,391.[17] Oza Swapnil *et al* 2018 with 80 samples with age 18-24 years old. The index plaque value before treatment with xylitol chewing gum was 1,08 and after treatment with xylitol chewing gum was 0,75 with the difference between before and after treatment being 0,33.[18] Kemthong Mitrakul *et al* 2017 with 81 samples with age 18-23 years old. The index plaque value before treatment with xylitol chewing gum was 1,35 and after treatment with xylitol chewing gum was 1,13 with the difference between before and after treatment was 0,22.[19]

Fatikarini in 2011 with 10 samples with age 18-24 years old. The index plaque value before treatment with xylitol chewing

gum was 1,026 and after treatment with xylitol chewing gum was 0,769 with the difference between before and after treatment was 0,257.[20]

Tabel 1. Xylitol chewing gum literature research result

References	Age (yrs)	Number of sample (n)	Index plaque before	Index plaque after	differences	p-value
Sumantri[16]	12-15	56	1,212	0,631	0,58	0,028
Saheer[70]	14-15	12	2,75	2,24	0,51	
Xiu-juan Li[71]	13-15	10	1,396	1,005	1,391	
Oza S.[72]	18-24	80	1,08	0,75	0,33	
Kemthong[73]	18-23	81	1,35	1,13	0,22	
Fatikarini[74]	18-24	10	1,026	0,769	0,257	
Mean			1,635	1,087	0,548	

Based on the literature on xylitol toothpaste, Research undertaken by Maden *et al* in 2017 with 16 samples from 13-15 years old. The index plaque value before treatment with xylitol toothpaste is 0,98 and after treatment with xylitol, toothpaste was 0,65 with the difference between before and after treatment being 0,33.[21] Shiddiek in 2018 with 45 samples. The index plaque value before treatment with xylitol toothpaste is 3,462 and after treatment with xylitol toothpaste was 1,220 with the difference between before and after treatment was 2,242.[22]

Tabel. 2 Xylitol toothpaste literature research result

References	Age (yrs)	Number of sample (n)	Index plaque before	Index plaque after	differences	p-value
Maden[75]	13-15	16	0,98	0,65	0,33	0,407
Shiddiek A.[76]	12-14	45	3,462	1,220	2,242	
Mean			2,220	0,935	1,285	

DISCUSSION

Results of literature research on xylitol chewing gum, the average plaque index before xylitol chewing gum was 1.635, and the average plaque index after treatment was 1.087. The difference before treatment and after treatment was 0.548. Based on the result of paired t-test on xylitol chewing gum, the test result on the difference in the decrease in plaque index before and after consuming xylitol chewing gum had a p-value of 0,028 which is smaller than the significance level of 0,05 ($p<0,05$).

The average plaque index before treatment with xylitol toothpaste was 2,220 and the average plaque index after treatment was 0,935. The difference before and after treatment was 1.285. Based on the results of paired t-test on xylitol toothpaste. The difference in plaque index reduction in xylitol toothpaste is known to have a p-value of 0.407 which is greater than the significance level of 0.05 so the test results show that there is no significant difference between before and after the use of xylitol toothpaste ($p>0,05$).

Based on Table 1, The decrease in plaque index with the highest value was found in the study of Li Xiu-Juan et al in 2010 in adolescents aged 13-15 years old, with the plaque index value before

treatment with xylitol chewing gum was 2,396 and the plaque index value after treatment with xylitol chewing gum was 1.005 with the difference before and after treatment was 1.391. The study was conducted using a double-blinded method.[17] The decrease in plaque index with the lowest value was found in the Kemthong Mitrakul study in 2017 in adolescents aged 18-23 years, with the plaque index value before treatment with xylitol chewing gum was 1.35 and after treatment with xylitol chewing gum was 1.13 with the difference before and after treatment was 0.22. The research was conducted using a cross-sectional study method.[19] Xylitol chewing gum can reduce plaque supported by research by Thabuis *et al* in 2014 in adolescents aged 13-15 years consuming xylitol chewing gum caused a decrease in plaque index due to an increase in plaque pH through a decrease in the presence of bacteria in the oral cavity.[23]

Based on Table 2, The decrease in plaque index with the highest value was found in Shiddiek's research in 2019 with a sample of junior high school students at SMPN 6 Banjarbaru class VIII with a plaque index value before treatment with xylitol toothpaste was 3,462 and a plaque index value after treatment with xylitol toothpaste was 1,220 with the difference before and after treatment was 2,242. The research was conducted using an experimental method with a quasi-design.[22] The decrease in plaque index with the lowest value was found in the study of Maden et al (2017) in adolescents aged 13-15 years, with the plaque index value before treatment with xylitol toothpaste was 0.98 and after treatment with xylitol toothpaste was 0.65 with the difference before and after treatment is 0.33. The study was conducted using a randomized controlled clinical trial method.[21] Xylitol toothpaste can reduce plaque supported by research by Barry *et al* in 2015 that brushing teeth with xylitol toothpaste is effective in controlling plaque. Xylitol does not reduce *Streptococcus mutants* in plaque but can inhibit the glycolysis of *Streptococcus mutans* growth.[24] Xylitol can accumulate *Streptococcus mutans* intracellurarly. *Streptococcus mutans* expends energy to break down accumulated xylitol without producing energy in return.[25] *Streptococcus mutans* bacteria do not have enzymes to utilize xylitol for the synthesis of extracellular polysaccharides and cannot utilize xylitol as an energy source to produce acid products.[26] Xylitol has the antibacterial ability through inhibition of bacterial growth. through metabolic reactions. The antibacterial properties of xylitol can be used as an adjunct to dental and oral hygiene.[25] Based on Tables 1 and 2, Xylitol chewing gum and xylitol toothpaste can reduce plaque

scores in the adolescent group. When compared with the two ingredients, xylitol chewing gum had greater effectiveness in reducing plaque index than xylitol toothpaste. According to Ravichandran *et al* (2019) who compared the two xylitol materials, namely xylitol chewing gum and xylitol toothpaste on salivary flow rate and salivary pH, it showed that xylitol chewing gum was more effective than xylitol toothpaste.[27] The salivary flow rate affects the formation of dental plaque. The lower the viscosity of saliva, the faster the salivary flow rate, and the higher the viscosity of the saliva, the build of dental plaque can occur.[28]

CONCLUSION

The decreased plaque index was established in both of the xylitol types, but not meaningful if used in toothpaste. Based on a statistical test, xylitol chewing gum had greater effectiveness in reducing plaque index than xylitol toothpaste.

ACKNOWLEDGEMENT

Our gratitude to the Faculty of Dentistry University Jenderal of Achmad Yani and several parties who helped with this research.

CONFLICT OF INTEREST

The researcher has no conflict with any party related to this research.

REFERENCES

1. Puspitasari A, Balbeid M, Adhirhesa A. perbedaan pasta gigi herbal dan non herbal terhadap penurunan plaque index score pada anak. e-Prodenta journal of Dentistry. 2018;2(1):116–23.

2. Bernabe E, Marcenes W, Hernandez CR, Bailey J, Abreu LG, Alipour V, et al. Global, Regional, and National Levels and Trends in Burden of Oral Conditions from 1990 to 2017: A Systematic Analysis for the Global Burden of Disease 2017 Study. Journal of Dental Research. 2020 Apr 2;99(4).

3. Lesar AM, Pangemanan DHC, Zuliari K. gambaran status kebersihan gigi dan mulut serta status gingiva pada anak remaja di smp advent watulaney kabupaten minahasa. e-GiGI. 2015 Dec;3(2):302–8.

4. Kusumawardhani N, Mubasyiroh R, Nainggolan O, Paramitha A. Laporan Nasional RISKESDAS 2018. Kementerian Kesehatan Republik indonesia ; 2018. 292–297 p.

5. Ramayanti S, Purnakarya I. peran makanan terhadap kejadian karies gigi . jurnal kesehatan masyarakat. 2013 Sep;7(2):89–93.

6. Atmadi L T A, Lestari S. Hubungan antara kebiasaan konsumsi makanan manis dengan karies gigi anak usia sekolah (The relation between habitual consumption of sweet foods with tooth caries of school age children). PDGI. 2016;65(2):56–9.

7. Rifky A, Hermina T. perbedaan efektifitas menyikat gigi dengan metode roll dan horizontal pada anak usia 8 dan 10 tahun di medan . Cakradonya Dent J. 2016 Jun;8(1):1–76.

8. Carranza FA, Newman MG, Takei H, klokkevold PR. Newman and Carranza's Clinical Periodontology, 13th Edition. Elsevier. 2019.

9. Elgamily HM, Gamal AA, Saleh SAA, Abdel Wahab WA, Hashem AM, Esawy MA. Microbiological and environmental assessment of human oral dental plaque isolates. Microbial Pathogenesis. 2019 Oct;135:2–3.

10. Elina L, Wahyuni S. pengaruh pengunyahan permen karet yang mnegandung sukrosa dan permen karet yang mengandung xylitol terhadap indeks plak gigi . jurnal keperawatan. 2017;8(1):1–5.

11. R R, PE A. The Effects of Xylitol Gum on the Bacterial Composition of Saliva and Plaque. IJDOS. 2017 Jun 27;4(6).

12. Fithrony H, Djulaeha E, Soedjono M. The influence of xylitol containing toothpaste on plaque formation inhibition on fixed bridge . Dent J. 2009 Sep;42(3):134–6.

13. Turska-Szybka A, Pasternok P, Olczak-Kowalczyk D. Xylitol Content in Dental Care and Food Products Available on the Polish Market and Their Significance in Caries Prevention. Dental and Medical Problems. 2016 Dec 13;53(4):542–50.

14. Maden E A, Altun C, Ozmen B, Basak F. Antimicrobial Effect of Toothpastes Containing Fluoride, Xylitol or Xylitol-probiotic on Salivary Streptococcus mutans and Lactobacillus in Children. Niger J Clin Pract. 2018 Feb;21(2):134–8.

15. Sumantri D, Syafitri F U. Pengurangan akumulasi plak gigi dengan membandingkan metode mengunyah permen karet xylitol dan berkumur teh hijau. JMKG. 2013;2(2):174–80.

16. Saheer A P, Parmar P, Majid A S, Bashyam M, Kousalya S P, Marriette M T. Effect of sugar-free chewing gum on plaque and gingivitis among 14–15-year-old school children: A randomized

controlled trial. IJDR. 2019 Mar;30(1):61–6.

17. Xiu-juan L, bin Z, Hua-xing X, Xiao-ping W. Comparative Effects of the Maltitol Chewing Gums on Reducing Plaque. West China Journal of Stomatology. 2010;28(5):502–4.

18. Oza S, Patel K, Bhosale S, Mitra R, Gupta R, Choudhary D. To determine the effect of chewing gum containing xylitol and sorbitol on mutans streptococci and Lactobacilli count in saliva, plaque, and gingival health and to compare the efficacy of chewing gums. Journal of International Society of Preventive and Community Dentistry. 2018 Jul;8(4):354–60.

19. Kemthong Mitrakul, Ratchapin Srisatjaluk, Kutkao Vongsawan, Chayanid Teerawongpairoj, Nachata Choongphong, Tathata Panich, et al. Effects of Short-Term Use of Xylitol Chewing Gum and Maltitol Oral Spry on Salivary Streptococcus Mutans and Oral Plaque. Southeast Asian J Trop Med Public Health. 2017 Mar;48(2):485–93.

20. Fatikarini I, Handajani J. Pengunyahan Permen Karet Gula dan Xylitol Menurunkan Pembentukan Plak Gigi. Maj Ked Gi. 2011 Jun;18(1):11–4.

21. Maden E A, Altun C, Acikel C. The Efficacy of Xylitol, Xylitol-Probiotic and Fluoride Dentifrices in Plaque Reduction and Gingival Inflammation in Children. Oral Health Prev Dent. 2017;15(2):117–21.

22. Shiddiek A P, Utami N K. Perbedaan dalam Penggunaan Pasta Gigi yang Mengandung Xylitol dan Baking Soda untuk Menurunkan Skor Plak pada Siswa SMPN 6 Banjarbaru. Jurnal Kesehatan Gigi. 2018 Dec;5(2):47–51.

23. Thabuis C, Cheng C Y, Wang X, Pochat M, Han A, Miller L, et al. Effect of Maltitol and Xylitol Chewing-gums on Parameters Involved in Dental Caries Development. ejpd. 2013;14(4):303–8.

24. Hoppers BL, Godoy FG. Plaque Reduction in Scholl Children Using a Disposable Brush Pre-Pasted with Xylitol Toothpaste. journal of tennessee dental association. 2015;94(2):25–8.

25. Aluckal E, Ankola A. Effectiveness of xylitol and polyol chewing gum on salivary streptococcus mutans in children: A randomized controlled trial. Indian Journal of Dental Research. 2018 Aug;29(4):445–9.

26. Aravinth H, Ganapathy D, Jain A

R. Role of Chewing Gum in Oral Hygiene Maintanance. Dit. 2018 Jan;10(2):2920–6.

27. Kathiresan Ravichandran, Jithesh Jain, Bhakti Jaduram Sadhu, S.R.Ananda, Rebecca Lilda. Comparative Evaluation of The Efficacy of Xylitol Toothpaste and Xylitol Chewing Gum on Salivary Parameters:An In-Vivo Study. JMDR. 2019;5(2):56–61.

28. Subekti A, Aryati Eko Ningtyas E, Benyamin B. Hubungan Plak Gigi, Laju Aliran Saliva, dan Viskositas Saliva pada Anak Usia 6-9 tahun. Jurnal Kesehatan Gigi. 2019;6:72–5.