Pricillia , The Difference In Salivary Ph On Removable Orthodontic Appliance Before And After Immersion With Sorbitol:. Journal of Health and Dental Sciences.e-ISSN 2807-3126 Vol. 02 No. 02: pp. 317-328

THE DIFFERENCE IN SALIVARY pH ON REMOVABLE ORTHODONTIC APPLIANCE BEFORE AND AFTER IMMERSION WITH SORBITOL

(PERBEDAAN pH SALIVA PADA PERANTI ORTODONTI LEPASAN SEBELUM DAN SESUDAH PERENDAMAN DENGAN SORBITOL)

Henry Anthonio Gozali[1], Pricillia Priska Sianita[1*]
[1] Department of Orthodontic Faculty of Dentistry Universitas Prof. Dr. Moestopo (Beragama) Jakarta Indonesia

*Corresponding author
ppsianita@gmail.com

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

Article History
Received:03/07/2022
Accepted: 03/08/2022

ABSTRACT

Orthodontic treatment with removable orthodontic appliances requires the patient's commitment to use the appliance in the mouth at a certain time. It can lead to specific changes in the mouth, such as a decrease in the level of acidity or pH of the mouth, which may be associated with increased biofilm accumulation. The acidity level of saliva in the mouth is an important factor in several oral problems, such as dental caries and periodontal disease. The use of mouthwash is still one of the simple ways that are widely used to overcome these problems. Among the many types of mouthwash on the market, sorbitol mouthwash is an option that can be used to prevent changes in the acidity level of saliva from reaching a critical value of $\leq$ 5.5 and endangering the oral health of orthodontic patients. This study aims to determine the change in salivary pH of patients in orthodontic treatment with removable appliances

before and after immersion with sorbitol mouthwash. The research method was an experimental laboratory study conducted with pre-test and post-test designs involving 33 samples divided into three groups, each consisting of 11 samples. Immersion time is divided into three categories, namely 15, 30, and 60 seconds. A pH indicator measures the level of saliva acidity. The results show that there are different changes in pH in each period of immersion. The conclusion was that immersion in sorbitol mouthwash resulted in changes in the pH level of saliva in removable orthodontic appliances, and the sufficient soaking time is 15 seconds.
Keywords: removable orthodontic appliances; salivary pH; sorbitol

ABSTRAK

Perawatan ortodonti dengan peranti ortodonti lepasan membutuhkan komitmen pasien untuk menggunakan peranti tersebut di dalam mulut. Hal ini dapat menimbulkan perubahan spesifik di dalam mulut seperti derajat keasaman atau pH yang mungkin berkaitan dengan meningkatnya akumulasi biofilm. Derajat keasaman saliva di dalam mulut merupakan salah satu faktor penting dalam beberapa penyakit di rongga mulut seperti karies gigi dan penyakit periodontal. Penggunaan obat kumur masih merupakan salah satu cara sederhana yang banyak digunakan untuk mengatasi permasalahan tersebut. Diantara obat kumur yang banyak beredar di pasaran, obat kumur sorbitol merupakan pilihan yang dapat digunakan untuk menjaga agar perubahan derajat keasaman saliva tidak mencapai nilai kritis $\leq$ 5,5 dan membahayakan kesehatan rongga mulut pasien perawatan ortodonti. Penelitian ini bertujuan mengetahui perubahan pH saliva pasien perawatan ortodonti dengan peranti lepasan sebelum dan sesudah perendaman dengan sorbitol. Penelitian eksperimental laboratorium dengan disain pre-test dan post-test, 33 buah sampel yang dibagi dalam tiga grup, masing-masing grup terdiri dari 11 sampel. Waktu perendaman dibedakan dalam tiga kategori, yaitu 15, 30, dan 60 detik. Derajat keasaman saliva diukur dengan indikator pH. Hasilnya menunjukkan bahwa terdapat

perubahan pH yang berbeda-beda dalam masing-masing periode waktu perendaman kesimpulan yang diperoleh adalah bahwa perendaman dalam sorbitol menghasilkan perubahan pH saliva pada peranti ortodonti lepasan dan waktu perandaman yang efektif adalah 15 detik.

***Kata kunci**: peranti ortodonti lepasan; pH saliva; sorbitol*

INTRODUCTION

Orthodontic treatment with removable orthodontic appliances is currently still being used. The removable orthodontic appliances used in this study are devices that can be inserted and removed by the patient, so patient discipline in treatment with this type of appliance is very much needed for the success of orthodontic treatment.[1] Generally, orthodontic treatment aims to correct the malocclusion. It improves dental and oral health, improves masticatory function, and provides comfort/confidence to patients.

Treatment with removable orthodontic appliances also has its advantages. Some advantages include shorter insertion times because they are made in a laboratory. The components of removable orthodontic appliances are generally not too conspicuous in the mouth. They don't disturb the patient's appearance too much; maintaining the cleanliness of the appliance is also much easier because the appliance can be removed by the patient and cleaned outside the mouth. It causes removable orthodontic appliances are still an option, especially for patients in the growing period.[2]

Removable orthodontic appliances generally have three components: an active component, a passive/retentive component, and a base plate (figure 1). Active components are components that are capable of producing tooth movement/ correction. In contrast, passive or retentive components are part of the appliance that helps the appliance hold its position in the mouth (not easy to fall off), and the last is the base plate which is the plate where the active and retentive components are attached.[3]

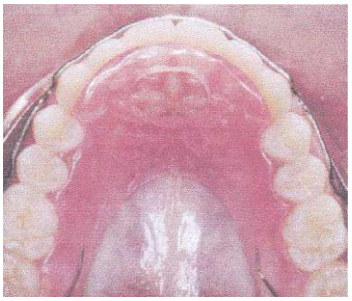

Figure 1. Removable orthodontic. appliance.[3]

Saliva is a complex oral fluid that combines various fluids and components excreted in the mouth.[4] 90% of saliva is produced by the major salivary glands. It Consists of the parotid gland with serous fluid secretion, submandibular and sublingual glands with seromucous fluid secretion. As much as 10% of saliva is produced by minor salivary glands scattered in several parts of the oral cavity, including in the labial and lingual areas.[5] Generally, the normal pH of saliva in the mouth is 7, and a decrease in pH below 5.5 can cause demineralization of enamel. And it increased caries risk. Therefore, saliva is important in maintaining the integrity of the enamel through the remineralization process so that dental caries do not occur. This remineralization involves the deposition of calcium phosphate from saliva to re-form dissolved enamel crystals.[6]

Factors that affect the composition and concentration of saliva include salivary flow rate, volume, pH, and buffering capacity.[7] Saliva helps mastication by forming a bolus by mucin. Saliva also helps digestion because it contains amylase enzyme, self-cleaning by cleaning bacteria and debris, protects the tooth surface by forming a pellicle, and has antimicrobial properties because it contains lysozyme, histatin, ferritin, statherin and immunoglobulin A (IgA).[8]

The original saliva consists of 94.0–99.5% water, organic and inorganic materials. The inorganic components of saliva include Na^+, K^+, Ca^{2+}, Mg^{2+}, CL, SO_4, H_2PO_4, and HPO_4. The main organic component is protein, lipids, glucose, amino acids, urea, ammonia, and vitamins are also found.[9] Normal salivary secretion without stimulation is 0.1 + 0.05 ml/min.[10] Mechanical stimulation, such as mastication, produces an average flow rate. Saliva varies from 3.15-4.94 ml/min.[11] Related to this, removable orthodontic appliances can be a stimulus. It can also trigger an increase in the flow of salivary secretions in varying amounts and is influenced by the patient's adaptation to the appliance in his mouth.

In this study, artificial saliva will be used, namely saliva made in the laboratory with a high degree of similarity to natural saliva in physics and chemistry.[12] Its composition was designed according to the Afnor method: Na_2HPO_4 0.26 gr/l. KSCN 0.33 gr/l, NaCl 6.0 gr/l, KH_2PO_4 0.20 gr/l, KCL 1.20 gr/l and $NaHCO_3$ 1.50 gr/l. Furthermore, the pH of this artificial saliva is balanced and controlled using HCL until it reaches the specified pH, which is 6.8.[13.] The degree of acidity (pH) of artificial saliva can be adjusted, and for this study, the pH of artificial saliva used was 5.5 to match the pH condition of the saliva

in oral cavity whenacidogenic bacteria such as *Streptococcus mutans* and Lactobacillus ideally develop.[13,14] This was achieved due to the combination of cellulose derivatives and albumin in the formulation.[15] The use of artificial saliva similar to real saliva is expected to support this study's objectives, explaining the difference in salivary pH in removable orthodontic appliances before and after immersion with sorbitol.

METHOD

A total of 33 samples of acrylic base plates from removable orthodontic appliances that were no longer used due to fractures or could not be used by patients were prepared for this study. The base plate is made in the same size, i.e., 10mm x 10mm x 2 mm (figure 2), so it can fully fit into the immersion plastic bags. The research sample in the form of a base plate was selected, which did not have pores on both the polished and unpolished surfaces (impression surface).

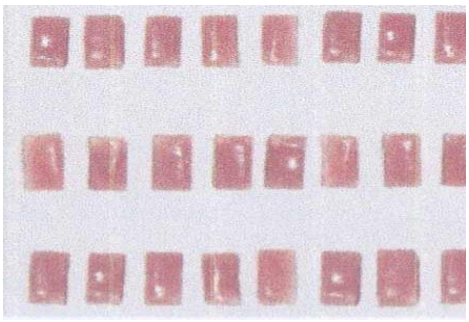

Figure 2. 33 acrylic base plates prepared for immersion in sorbitol.

For immersion, a solution of sorbitol was prepared. Sorbitol is unique sugar alcohol because it does not have a carbonyl group in its chain, so it is chemically less reactive than sugars with aldose and ketose bonds. As a result, it is less aggressive in forming acids in dental plaque. In Indonesia, sorbitol is produced from starchy root crops such as cassava (Manihot Utilissima Pohl) which belongs to the *Euphoribiaceae* family. In addition, sorbitol can also be found in the red algae *Bostrychia scorpiodes* which contain 13.6% sorbitol. Berries of the *Sorbus Americana* species contain 10% sorbitol. *Rosaceae* family, such as pears, apples, cherries, prunes, peaches, and apricots, also contain sorbitol.

Sorbitol is also produced in human tissues due to the catalysis of D-glucose by the enzyme aldose reductase, which changes the aldehyde (CHO) structure in the glucose molecule to become alcohol (CH_2OH).[16] Sorbitol is very soluble in water.[17] Sorbitol does not cause toxic effects, so it is safe for human consumption, does not cause dental caries, and is a very useful sugar for people with diabetes mellitus and those who must undergo a low-calorie diet.[18] In this study, a mouthwash containing sorbitol circulating in the market

was used, while the artificial saliva used had a pH of 5.5.

The prepared base plates were divided into three groups, each consisting of 11 base plates. Then the base plate in each group was immersed in artificial saliva for 10 seconds, removed, and put in a plastic zip. The initial pH 1/measurement (Figure 3) was carried out using a pH indicator (Figure 4).

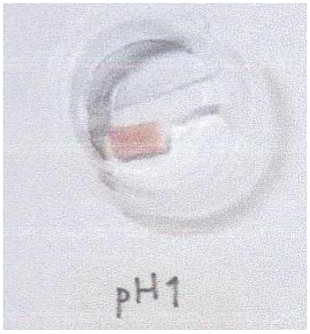

Figure 3.pH 1 or initial pH.

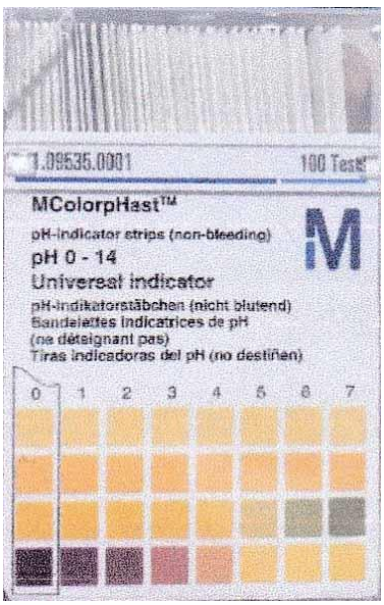

Figure 4. Universal pH indicator.[19]

After the initial pH was measured and recorded, the base plate was soaked in sorbitol for 15 seconds. After that, the base plate was put back into artificial saliva and measured with a pH indicator to get a pH value of 2 (Figure 5).

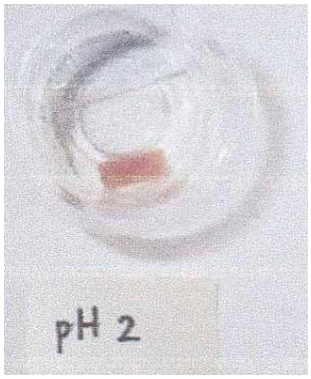

Figure 5. pH 2.

The same measurement pattern was carried out to obtain the values of pH 3 and 4, but with immersion time in sorbitol of 30 seconds for pH 3 (Figure 6) and 60 seconds for pH 4 (Figure 7). The process is done until all samples in each group have been measured dan recorded.

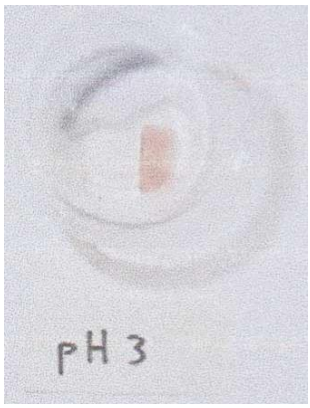

Figure 6. pH 3.

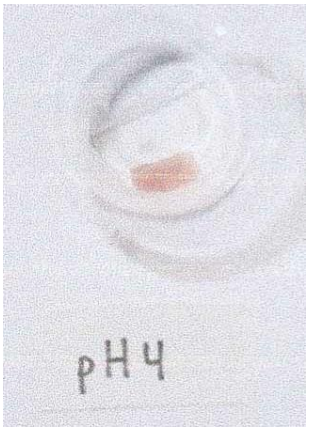

Figure 7. pH 4.

Data Analysis

The ratio scale data in this study will first undergo a distribution normality test using the Shapiro-Wilk. If it is proven that the data is normally distributed, then it can be continued with a parametric statistical test. However, suppose the data is not normally distributed. In that case, the statistical test is then carried out with non-parametric tests to see the difference in salivary pH on removable orthodontic appliances before and after immersion with sorbitol.

RESULT

This research was carried out after obtaining a letter of ethical review with no: 092/KIP/FKGUPDMB/VII/2019/ The data obtained in this study first underwent a distribution normality test with Shapiro-Wilk (Table 1), and the test results showed that the data were normally distributed ($p<0.05$).

Furthermore, a statistical parametric independent t-test was carried out to see whether there was a difference in salivary pH before and after immersion with the sorbitol for 15 seconds. The results obtained show the value of Sig. (2-tailed) is smaller than (0.05). Thus, it can be understood that there are differences in the pH value of saliva on removable orthodontic appliances before and after immersion with sorbitol.

Table 1. Independentt-test on the second artificial saliva pH value (pH 2)

	F	*Sig.*	*t*	*df*	*Sig. (2-tailed)*	*Mean difference*	*Str Error Difference*	*95% confidence interval of the difference*	
								lower	*upper*
Equal variances assumed	4.938	0.38	4.5	20	.000	.40909	.09091	.21946	.59872
Equal variances not assumed			4.5	10	.001	.40909	.09091	.20653	.61165

The same statistical test was carried out on the measurement results of pH 3 (Table 2), the group with the immersion time in sorbitol for 30 seconds. The results obtained also show the value of Sig. (2-tailed) which is smaller than the value of α (0.05). Thus, it can be understood that there are differences in salivary pH in removable orthodontic appliances before (pH 1) and after immersion (pH 3) in sorbitol for 30 seconds (Table 2).

Similarly, the statistical test for the

fourth artificial saliva pH value (pH 4), with immersion time in sorbitol for 60 seconds (Table 3). The results obtained showed that the value of Sig (2-tailed) was smaller than the value of α (0.05). Thus, it can also be understood that immersion in sorbitol for 60 seconds resulted in a difference in salivary pH in the removable orthodontic appliance.

Table 2. Independent-t-test on the third artificial saliva pH value (pH 3)

	F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Str Error Difference	95% confidence interval of the difference	
								lower	upper
Equal varian ces assum ed	14.69	0.01	5.5	20	.000	.69182	.12197	42740	.93624
Equal varian ces not assum ed			5.5	10	.000	.69182	.12197	41006	.95358

Table 3. Independentt-test on the fourth artificial saliva pH value (pH 4)

	F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Str Error Difference	95% confidence interval of the difference	
								lower	upper
Equal varian ces assum ed	4.938	0.38	15.5	20	.000	1.40909	.09091	1.21946	1.59872
Equal varian ces not assum ed			15.5	10	.000	1.40909	.09091	1.20653	1.61165

DISCUSSION

Salivary pH measures the hydrogen ion concentration of the aqueous solution, indicating whether the solution is acidic, alkaline, or neutral in saliva.[20] Several factors that play a role in causing changes in salivary pH to include salivary flow rate, buffering capacity, and microorganisms in the oral cavity.[21] Orthodontic treatment requires patients to be disciplined in using their appliances, especially removable orthodontics appliances. The presence of the orthodontics appliances in the patient's mouth also provides an additional attachment area for oral bacteria, which will affect the acidity (pH) of oral saliva. This condition can be aggravated if the patient is also not disciplined in maintaining the cleanliness of his oral cavity.

Meanwhile, a decrease in the acidity (pH) of saliva that reaches a value of < 5.5 (critical value) is believed to be able to increase the potential for other problems such as dental caries and periodontal disease. Thus, patient discipline in maintaining oral hygiene is the key to maintaining good oral health during treatment with removable orthodontic appliances. This discipline is important because, generally, orthodontic treatment requires time that varies depending on the case's level of complexity and the patient's cooperation. Based on this, it can be estimated that the potential for using removable orthodontic appliances for more than 5-6 months (duration of treatment) is very real. Suppose for a fairly long period. The patient is unable to maintain the cleanliness of his oral cavity; then, in addition, dental health problems will arise.

In that case, the orthodontic treatment in these patients is also at risk of failure. In this regard, it is known that some mouthwashes can contribute to helping maintain a better salivary acidity (pH) for the patient's oral health.

This experimental laboratory study involved using mouthwash containing sorbitol to explain changes in salivary pH that could be caused by observing and comparing saliva's acidity (pH) in removable orthodontic appliances before and after immersion with sorbitol. The pH value was measured using a universal pH indicator per the manufacturer's instructions, which is to match the standard given on the box to determine the pH value of the saliva sample. This measurement model was applied to all samples (33) involved in this study, divided into three groups consisting of 11 base plates. The data obtained were recorded for further statistical analysis to answer the research objectives.

The statistical test (independent t-test) results showed that immersion in sorbitol resulted in differences in saliva's pH value/degree of acidity. This difference in pH values was even seen in three different immersion times, and the p-value < from the probability value of 0.005 for the three groups in this study.

Changes in salivary pH in removable orthodontic appliances before and after immersion in sorbitol obtained in this study cannot be separated from the ability of sorbitol to change salivary pH, as stated in the study of Pratiwi et al. (2001). This information is expected to provide additional or varied choices for people who use removable orthodontic appliances to maintain the health of their oral cavity during orthodontic treatment.[22] Moving from the results of this research that showed changes in saliva pH before and after immersion in sorbitol in three categories of immersion duration, it can be assumed that the immersion time or duration of 15 seconds can be considered effective in producing changes in salivary pH.

CONCLUSION

Based on the research data obtained, it can be concluded that there is a difference in salivary pH ($p<0.05$) on removable orthodontic appliances before and after immersion with sorbitol.

CONFLICT OF INTEREST

The researcher has no conflict of interest with any party in this research.

ACKNOWLEDGEMENT

The researcher would like to express gratitude to several parties who

have helped so that this research can be carried out properly and smoothly until it is finished.

REFERENCES

1. Ardhana., W., Identifikasi perawatan ortodontik spesialistik dan umum, Maj. Ked. Gi. 2013; 20(1): 1-8.
2. Mahardika,R., Ismah,N., Purwanegara,M., Efektifitas perendaman alat ortodonti lepas dengan bahan pembersih gigi tiruan terhadap perubahan pH Saliva pada pasien di RSGM-P di FKG UI, Journal of Dentistry Indonesia, 2013;7:35-41.
3. Goenharto,S, Rusdiana,E., Khairyyah,I., Comparison between removable and fixed orthodontics retainers. Journal of Vocational Health Studies, 2017; 1(12):82-7.
4. Arvina, Chismirina,S.,Amirza,N., Perubahan pH saliva sebelum dan sesudah mengkonsumsi buah pisang ayam (*Musa Acuminate colla*) pada mahasiswa FKG UNSIAH Angkatan 2014. Cakradonya Dent.J. 2014; 10(1): 44-48.
5. Haroen,E., Studi reologik substitusi saliva sebagai pengembangan dari saliva alami manusia. Jurnal Bionatura 2001; 3(1):1-7
6. Nasution A.,Gani B., Asbarini F., Perubahan pH saliva buatan setelah diinteraksikan dengan *Candida albicans, Streptococcus mutans* dan Agregat bakteri *Actinomytomi cetemcomitans*. Cakradonya Dent.J. 2013; 5(2): 542-618.
7. Pradanta,Y., Adhani, R., Khatimah, I., Hubungan kadar pH dan volume saliva terhadap indeks karies masyarakat menginang Kecamatan Lokpaikat Kabupaten Tapin (Studi observasional dengan pengumpulan saliva metode spitting) Dentino J.2016; 1(2): 563-564.
8. Wirawan, E., Puspita,S., Hubungan pH saliva dan kemampuan buffer dengan DMF-Tdan def-t pada periode gigi bercampur anak usia 6-12 tahun. Insisiva Dental Journal2017; 6(1): 25-31.
9. Indriana, T., The relationship between salivary flow rate and calcium ion secretion insaliva stomatognatic. JKG Unej. 2010; 7(2): 129-131.
10. Ayuningtyas G., Harijanti K., Soemarijah, S.Penurunan sekresi saliva dan terjadinya kandidosis mulut pada lansia oral medicine. Dental Journal 2009; 1(1): 6-10.
11. Lewapadang,W., Tendean,L., Anindita, P., Pengaruh mengonsumsi nanas *(Ananascomosus)* terhadap laju aliran saliva pada lansia penderita xerostomia. E GiGi. Journal 2015; 3(2): 454-459.

12. Langen,E., Rumampuk,J., Leman, M., Pengaruh saliva buatan dan belimbing wuluh*(Averrhoa bilimbi L.)*terhadap kekerasan resin komposit nano hybrid.eJournal, 2017; 6(1): 9-15.
13. Amal, A., Hussain, S., Jalaluddin, M. Preparation of artificial saliva formularion. ICB Pharma. 2015; 2:7-15.
14. Alpoz,E., Guneri, P., Onder, G., Cankaya,H., Kabasakal, Y., dan Kose,T., The Efficacyof Xialine® in patients with Sjogren's syndrome; a single-blind, cross-over study, Clin Oral Invest. 2008; 12: 165-172.
15. Barcelos, AM., Luna,AS., Ferreira, NA., Braga,AV., Lago, DC., senna,LF. Corrosion evaluation of orthodontic wire in artificial saliva solution by using respons surface. Methodology Material Research. 2013; 16(1): 51-55
16. Soesilo, D., Santoso,R., Diyatri,I., Peranan sorbitol dalam mempertahankan kestabilan pH saliva pada proses pencegahan karies. Airlangga Dental Journal 2005; 38(1): 25-28.
17. Yap. J.Harmita, Suryadi, H., Optimasianalisis campuran maltitol, manitol, sorbitol dan xylitol secara kromatografi cair kinerja tinggi. Jurnal Biologi, 2016; 6(2):1-7.
18. Aini,F., Affandi,D., Basito.Kajian Penggunaan pemanis sorbitol sebagai pengganti sukrosa terhadap karakteristikfisik dan kimia biskuit berbasis tepung jagung (*Zeamays*) dan tepung kacang merah (*Phaseoulus vulgaris L*.). Jurnal Teknologi Hasil Pertanian 2016; 9(2): 22-33.
19. Makoginta, ZP.,Wowor, V., Juliatri, P.,Pengaruh berkumur air kelapa muda terhadap pH saliva. Jurnal Farmasi UNSRAT. 2017; 6(1): 24-31.
20. Zulius,A. Rancang bangun monitoring ph air menggunakan soil moisture sensor diSMK N 1 Tebing Tinggi Kabupaten Empat lawang. JUSIKOM 2017; 2(1): 37-44.
21. Haryanti,W., Siregar, I., Ratnaningtyas,IA. Buah mentimun dan tomat meningkatkan derajat keasaman (pH) saliva dalam rongga mulut. Jurnal Riset Kesehatan 2016; 5(1): p. 21-24.
22. Pratiwi,T., Sutadi,H., Mangundjaja, S.,Apriati,Y., Pengaruh sorbitol dalam permen terhadap populasi *Streptococcus mutans* dalam saliva. Maj. Ked.Gigi (Dent.J) 2001;38(1): 25-28.