EFFECTIVENESS OF DENTIFRICE CONTAINING XYLITOL ON SALIVARY MUTANS STREPTOCOCCI

Heriandi Sutadi*, Soeherwin Mangundjaja** and Andika D. Kartikasari**
*Department of Pediatric Dentistry and **Department of Oral Biology
Faculty of Dentistry Universitas Indonesia

ABSTRACT

Objectives: The aim of this study is to investigate the effectiveness of dentifrice containing xylitol on the growth of salivary mutans streptococci. The amount of salivary mutans streptococci which was taken before and after tooth brushing from the groups using dentifrice containing xylitol and non-xylitol dentifrice are compared. The study was carried out to investigate the effect of dentifrice containing xylitol in inhibiting the growth of salivary mutans streptococci. Method: Before enrolled in the study, respondents fill and signature the informed consent. Sixty subjects had participated on this study, and divided into two groups: The data of salivary sample from each thirty subjects either as a treatment or control group, were collected before and after tooth brushing with dentifrice containing xylitol and non-xylitol. A serial dilution was made and followed by inoculating on TYS20B medium. Data which were obtained from colony forming unit of salivary mutans streptococci grew on the TYS20B medium before and after tooth brushing. “t” - test analysis was used for mutans streptococci difference between before and after treatment. Results: The result showed that there was highly significant difference (p < 0.001) between before and after tooth brushing with dentifrice containing xylitol and non-xylitol. Conclusion: Therefore it could be concluded that dentifrice contained xylitol is effective in inhibiting the growth of the salivary mutans streptococci.

Key words: Dentifrice-Sorbitol-Salvary Mutans Streptococci

INTRODUCTION

Data from Directorate of Health Republic of Indonesia has declared that 60-80% of population was suffering from dental caries. These data were also supported by prevalent of dental caries finding among children of preschool age in Jakarta in 1988 which was 85.17% with def-t mean 6.04. Dental caries increased appropriate with the increasing of age: def-t index on children 1 years old around 0.91; on 2 years old 4.13; on 3 years old 7.80; and on children 4 years old 10.40. One of the most important etiology of dental caries is oral hygiene particularly Streptococcus mutans harboured in the dental plaque. Beside that daily sugar intake like sucrose could be taken a part to increase the growth of mutans streptococci.

Dental caries remains as a significant health which threat in everywhere, and also as a prominent target of many dental health care in Indonesia, where most of the population suffers from dental caries and periodontal disease. These data also were supported by Heriandi (1992), who indicated that dental caries increased approximately 100 percent on children of under 5 years old in every year. According to National Health Survey on 1995, the dental caries and periodontal disease are the most commonly
diseases which were suffered by Indonesian population with DMF-T is approximately about 2.5.

The results of this study also stated that 80% of population had tooth brushes and had realized about the importance of dental health, but they were not really educated enough on oral hygiene in controlling dental caries bacteria. Dental caries is a multifactorial disease caused by interaction of host, cariogenic diet, and bacteria.

The evidence is overwhelming that *Streptococcus mutans* is the primary etiological agent in the dental caries. Acidogenicity and aciduricity are important biochemical characteristic for cariogenicity of microorganisms. The mutans streptococci have both of these properties and are considered as the most cariogenic group within the oral micro-flora. For this reason, early prevention is needed to maintain the oral health by tooth brushing regularly using dentifrice. It is the most widely used and socially accepted system of oral hygiene.

Tooth brushing is the principal way to mechanical removal of plaque and to prevent *Streptococcus mutans* colonized in teeth. It is combined with dentifrice to have a greater effect in protecting the oral health by reducing the population of plaque and salivary mutans streptococci. Recently, many kinds of dentifrice have been found in the market, with many kinds of brands and utilities. Xylitol is un-fermentable artificial sugar. It is simple sugar alcohol (pylyiol) of five carbons or pentitol type, occurring naturally in small quantities in fruits, berries, or other plant parts as well as a normal intermediate metabolite of the human carbohydrate metabolism. Although this pentose alcohol occurs in some fruits and seeds, it is manufactured by catalytic reduction of xylose derived from xylans of birchwood. Xylitol is isocaloric with sucrose and have cooling taste.

At present, it is used as sweeteners in candies, chewing gum, substitute sugar, pharmaceuticals, and dentifrice. The aim of this study is to investigate the effectiveness of dentifrice containing xylitol on the growth of salivary mutans streptococci. The amount of salivary mutans streptococci which was taken before and after tooth brushing with dentifrice containing xylitol and non-xylitol dentifrice as a control would be compared.

**MATERIAL AND METHODS**

Sixty subjects participated in this study. All were in good general and oral health with no evidence of progressive periodontal disease and no untreated caries. The subject with appliances or denture and taking medication during the study were not allowed in this study.

They were asked to maintain normal dietary habit; 3 meals time daily including snacks between meals. All subjects divided into two groups; treatment and control group. They were observed in two kinds of treatment in seven days.

Two kinds of dentifrice were tested; dentifrice containing xylitol (treatment group) and non-xylitol (control group). The saliva was collected to analyze the quantiti of salivary *Streptococcus mutans*. 
Samples Collection and Bacteriological Procedures

Before tooth brushing with dentifrice containing xylitol and non-xylitol, subjects is instructed to chew contiously sterilized paraffin for 30 seconds. Then saliva samples were collected, one milliliter and serial diluted. From the dilution 0.1 milliliter was taken and inoculated on TYS20B (Trypticase Yeast Extract Cystine with Bacitracin) agar for the growth of Streptococcus mutans. The TYS20B agar plates were inoculated in an anaerobic jar filled with 95 % N 2 and 5% C02 at 37° Celsius degree for 72 hours.

The number of total colony forming unit (CPU) of mutans streptococci on TYS20B were examined and counted with the aid of dissecting microscope. Subjects were asked to brush their teeth twice a day with dentifrice containing xylitol and non-xylitol in seven days.

Saliva samples after tooth brushing with dentifrice containing xylitol and non-xylitol were collected, inoculated, and incubated with the same way as mention above before tooth brushing with both dentifrices.

Statistical analysis

Data were obtained from the colony forming unit (CPU) of salivary mutans streptococci which grew on the TYS20B medium. “t”- test analysis were used to see difference amount of Colony Forming Units of mutans streptococci between before and after tooth brushing with dentifrice containing xylitol and non-xylitol.

RESULTS

The results of analyzed CPU amount of Streptococcus mutans which grew on TYS20B media before and after tooth brushing with dentifrice containing xylitol and non-xylitol are shown in table 1.

Table 1. Mean and Standard Error of CPU Streptococcus mutans on before tooth brushing and after tooth Brushing with xylitol-containing dentifrice and non-xylitol Groups

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SE</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before –non-Xylitol</td>
<td>575.575</td>
<td>81.471</td>
<td>30</td>
</tr>
<tr>
<td>After – non – Xylitol</td>
<td>462.767</td>
<td>65.471</td>
<td>30</td>
</tr>
<tr>
<td>Before-Xylitol</td>
<td>575.575</td>
<td>81.471</td>
<td>30</td>
</tr>
<tr>
<td>After - Xylitol</td>
<td>283.600</td>
<td>46.203</td>
<td>30</td>
</tr>
</tbody>
</table>

In table 1. Had been shown that CPU of Streptococcus mutans after tooth brushing with xylitol-containing dentifrice is lower than before tooth brushing with dentifrice containing xylitol or non-xylitol. It is also lower than after tooth brushing with non-xylitol dentifrice.
Table 2. Statistical Analysis on Treatment with Dentifrice before and after Tooth Brushing Containing Xylitol and non-Xylitol

<table>
<thead>
<tr>
<th></th>
<th>DF</th>
<th>t-value</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before-After tooth brushing(non-xylitol)</td>
<td>29</td>
<td>-4.51</td>
<td>0.001</td>
</tr>
<tr>
<td>Before-After brushing (xylitol)</td>
<td>29</td>
<td>-5.52</td>
<td>0.001</td>
</tr>
<tr>
<td>After tooth brushing (non-xylitol- xylitol)</td>
<td>29</td>
<td>4.85</td>
<td>0.001</td>
</tr>
</tbody>
</table>

T-test analysis was used to see the significance of the effectiiveness of dentifrice containing xylitol, and the result can be seen in table 2.

The amount of salivary mutans streptococci showed a highly significant difference between the CPU of *Streptococcus mutans* before and after tooth brushing with non-xylitol containing dentifrice (p < 0.001). And when CPU of *Streptococcus mutans* before tooth brushing with xylitol dentifrice compared to after tooth brushing with xylitol containing dentifrice, were also highly significant difference (p < 0.001).

After tooth brushing with non-xylitol dentifrice compared to after tooth brushing with xylitol-containing dentifrice also showed highly significant difference (4.85; p<0.001).

**DISCUSSION**

The results in table I had shown that the amount of CFU of *Streptococcus mutans* after tooth brushing with xylitol-containing dentifrice lower than the amount of CPU of *Streptococcus mutans* after tooth brushing with non-xylitol dentifrice. After using non-xylitol dentifrice the CPU of *Streptococcus mutans* decreased comparing with the CPU of *Streptococcus mutans* before using non xylitol dentifrice. Considering its un-fermentable characteristic, xylitol could prevent bacteria from producing acid.

The virulence of mutans streptococci is caused by its ability to produce glucose polymers or glucan which is the material from dental plaque. *Streptococcus mutans* was able to synthesize glucan from sucrose and catalyzed by glucosyltransferase, through anaerobic glycolysis to become lactate, propionate, and acetic acid, and then the pH plaque will decrease. The acidic environment gives selective growth and amplification for oral acid tolerant bacteria such as *Streptococcus mutans*.

Due to this condition as un-fermentable sugar, the presence of xylitol in oral might reduce the population of mutans streptococci. This is in accordance to previous findings suggestion that sugar alcohol like xylitol are metabolized poorly or not at all by oral bacteria, and do not produce a pH drop. It was found that the pH drop after chewing xylitol gum was very small or not existing. None of the predominant bacteria of dental plaque produce acid from xylitol, and its presence reduces acid production from glucose either in vivo or in vitro.

The other researcher had found that xylitol would allowed the organism to respond the excess of carbohydrate, and reducing the rate and extent of acid production. Research study found that xylitol suppressed the growth of *Streptococcus mutans*.
Other research suggested that xylitol in chewing gum decreased the level of mutans streptococci either in saliva or plaque and caused no measurable drop in plaque pH.\textsuperscript{10,11,13,14} The results from table 2 showed that there was highly significance difference in the average amount of Streptococcus mutans colonies between before and after tooth brushing with dentifrice containing xylitol. From the analysis can be concluded that dentifrice containing xylitol is effective in inhibiting the growth of \textit{Streptococcus mutans}.

The detailed mechanism itself which xylitol shows its anticariogenic effect is still not well known, although several hypothesis have been proposed. If xylitol has replaced sugar in snacks consumption, the frequency of acid production on the enamel has been lowered. If chewing gums contains xylitol, the saliva flow would be stimulated and encouraging remineralization.

The other study using chewing gum containing sorbitol was conducted by Roeslan and others (1994) considering the effect of chewing gum on the growth of plaque \textit{Streptococcus mutans} and had concluded that chewing gum containing sorbitol could decreased the amount of \textit{Streptococcus mutans} colonies and caries activity.\textsuperscript{11,14} Another mechanism is by metabolic inhibition. The microorganism attempt to get rid of the non metabolically xylitol, which demanding on energy, creating a negative energy cycle in which the bacteria loose energy without producing acids. As this process tend to reduce the growth rate and acid production, it can possibly lead to reduced level of mutans streptococci and caries in habitual users of xylitol containing products.

This could be a reason of the result of this study which had showed that the amount of CFU of mutans streptococci after tooth brushing with dentifrice containing xylitol is lower than CPU of \textit{Streptococcus mutans} after tooth brushing with non xylitol dentifrice

\textbf{CONCLUSION}

There was highly significance difference in the average amount of \textit{Streptococcus mutans} colonies between before and after tooth brushing with dentifrice containing xylitol and non xylitol. The dentifrice containing xylitol is effective in inhibiting the growth of salivary mutans streptococci.

\textbf{REFERENCES}\n

Presented at the FDI Annual World Congress 27 September - 1 October 2001 Kuala Lumpur Malaysia