The Effect of Enzyme Dentifrice on Caries Activity of Mutans streptococci in Plaque

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ABSTRACT

Objectives: This study is purposed to examine the effect of tooth brushing with dentifrice containing Amiloglucoseoxidase and Glucoseoxidase enzyme on caries activity of mutans streptococci in plaque. Method: Twenty respondents were treated as treatment group by tooth brushing with enzyme dentifrice and also being control group with non-enzyme. Plaque samples were taken from areas of buccal tooth surfaces, then diluted in a small tube of Cariostat (Tzu Shimon & et al, 1986) and incubated in anaerobic jar for 48 hours. Data were obtained from Cariostat were analyzed using "t" test and using percentages based on grades changing pH of Cariostat. Results: showed that there was significant difference in increasing pH between control group and treatment group. Percentages of increasing pH between control group and treatment group were about 5 to 80 %. Conclusion: It could be concluded that tooth brushing with enzyme dentifrice is effective in reducing caries activity of mutans streptococci in plaque.

Key words: Enzyme- Dentifrice - Caries Activity - Mutans streptococci - Plaque

INTRODUCTION

The Directorate of Oral Health of the Indonesian Ministry of Health has stated that 60 - 80 % of population is suffering from dental caries and toothache is the 6th most common diseases in Indonesian society . So this is a challenge for dental profession to lower the rate of dental caries.

Oral cavity is main gate for microorganism entrance. Actually the existence of microorganism in oral cavity is normal. But if their number is uncontrolled, they can cause disorders in oral cavity. The most common infection is caries and periodontal diseases.
Dental caries which is known the most common ailment of the mouth is found to be caused by \textit{Streptococcus. mutans}, however, \textit{Streptococcus mutans} is not the sole contributing of caries. The cause of dental caries is multifactor, which consist of four mutually influencing factors. The first factor is host, i.e. the condition of teeth and saliva. The second factor is microorganism. In this case is \textit{Streptococcus mutans}. The third factor is substrate especially sucrose. And the last one is time factor.

Various effort to prevent dental caries have been done. The simplest and most common effort is tooth brushing regularly with toothpaste or dentifrice.

Nowadays, there are many toothpastes with various trademarks and benefits available in market, so consumers are demand to select one that is most beneficial for oral cavity hygiene.

There for it is a challenge for dentistry to develop research in order to reduce caries risk in the future. This research we try to examine the effect of dentifrice containing enzyme assumed to be able to reduce caries activity effectively.

\textbf{1.2 The Objective of Research}

The objective of this research is evaluating the influence of toothpaste containing enzyme in reducing caries activity of \textit{Streptococcus mutans} in plaque.

\textbf{1.3 The Research Formulation}

Does the use of dentifrice containing enzyme Amiloglucosidase and Glucoseoxidase regularly will reduce caries activity of \textit{Streptococcus mutans} in plaque?

\textbf{1.4. The Benefit of Research}

This research is expected to contribute significantly to the world of science that toothpaste containing enzyme can reduce caries activity, therefore in a long term of using dentifrice containing enzyme, caries can be prevented.
1.5. Hypothesis

Tooth brushing with dentifrice containing enzyme is influence in reducing caries activity of *Streptococcus mutans* in plaque.

LITERATURE STUDY

Currently we know that *Streptococcus mutans* are triggering factor of caries because their characteristics always are related to caries process. *Streptococcus mutans* can synthesize insoluble glucan with (1,3) bond from sucrose, besides that *Streptococcus mutans* can produce lactic acid by homofermentation.

*Streptococcus mutans* are also more aciduric than other streptococci group. *Streptococcus mutans* are normally found in human oral cavity, usually in tooth plaque. *Streptococcus mutans* habitat is not evenly spread in entire tooth surface. They are mostly found in pit and fissure, occlusal surface, proximal area and gingival sulcus.

Plaque is the center of study for *Streptococcus mutans*, this bacteria had been isolated and identified in many ethnic population with different social and economic background.

Epidemiological research local strains of mutans streptococci has been found in student oral cavity in Surabaya and labeled as ; Sm1, Sm2,Sm3, Sm4, Sm5 and Sfm6. Sm3 morphology is similar with Inggrite serotype of *Streptococcus mutans* found in English man's oral cavity.

According to oral cavity research of people in Kepulauan Seribu, local strains of mutans streptococci has been found and labeled as: Sm1, Sm2,Sm3 and Sm4. Morphology of Sm1 is similar with serotype d *Streptococcus sobrinus* B13 found in Swedish's oral cavity.

As above mentioned that glucose produced from sucrose metabolism and other glucose from saliva will be metabolized by *Streptococcus mutans* through homo fermentation to produces energy for *Streptococcus mutans* life. Homo fermentation has side product, i.e. lactic acid.

Lactic acids as side product of *Streptococcus mutans* metabolism will cause acidity of plaque increase in minutes. The results is plaque pH will become less that 5 in 1-3 minutes. But plaque pH will return to normal by 30-60 minutes.

The acid will dissolve some minerals in enamel. The acid releases hydrogen ion and that will react with apatite crystals to form unstable apatite
crystal. Beside the acid will also produce soluble phosphate, which can destroy enamel membrane.

\[ \text{Ca}_{10}(\text{PO}_4)_6 + 8\text{H}^+ \rightarrow 10\text{Ca}^{2+} + 6\text{HPO}_4^{2-} + 2\text{H}_2\text{O} \]

Dental caries process does not last in days or weeks but in months or years. It is due to the ability of saliva to redeposit mineral while dental caries process occurs.

The ability of saliva is limited because if the acid produced by plaque is excessively abundant, saliva can not balance to condition, and caries process occurs.

Therefore, we need a method to prevent caries and maintain normal ecology in oral cavity by tooth brushing with dentifrice regularly.

As stated in literature that LPO system (Lactoperoxidase - thiocyanate Hydrogen Peroxide System) can inhibit the metabolism of cariogenic microorganism in the oral cavity. Lactoperoxidase enzyme consists of six iso enzymes which catalyze peroxidase reaction. Lactoperoxidase can be in active easily and according to Pickering et al 1962, most of Streptococci can make the enzyme inactive by using Hydrogen peroxidase of H_2O_2 from their metabolism.

The diagram is as follows:

![Diagram of Lactoperoxidase mechanism](image)

Figure 1 Inactivation of lactoperoxidase enzyme. (Hendrik Doorn 1974. The effect of Lactoperoxidase - Thiocyanate - Hydrogen peroxide on the metabolism of cariogenic microorganism in vitro and in the oral cavity)
Lactoperoxidase reacts with one molecule of H₂O₂ to yield Compound(C) I.

An electron from SCN⁻ reduces CI to be CII. SCN ion can act as electron donor. It protects lactoperoxidase against this form of oxidation. CII is compound to be maintained because it can stimulate lactoperoxidase synthesis. CII reacts with H₂O₂, to yield CIII, which spontaneously turns to inactive CIV. CII also can spontaneously turn to CI again.

In order that CII can be maintained, two mechanisms are needed:

a. CIII shall be turned to CII by catalase.
b. CI needs an electron from SCN⁻ to be come CII. Therefore SCN⁻ is very important for lactoperoxidase system.

Lactoperoxidase is an important oxidative enzyme of saliva. Lactoperoxidase acts as bacteriostatic when combined with H₂O₂ and SCN⁻. The combination creates lactoperoxidase system (LPO system).

Thiocyanate (SCN⁻) is sufficient in human saliva to active LPO system. Hydrogen -peroxide (H₂O₂) is produced by oral microorganism, but its level in saliva is insufficient to active the system. The optimal level of H₂O₂ in saliva to active the system should be 30 to 300 microM. That is the reason why additional external H₂O₂ is needed, for example from dentifrice.

So, LPO system is applied in dentifrice by adding two specific enzymes to increase H₂O₂ in saliva. The enzymes are Amiloglucosidase (AG) and Glucoseoxidase (GO).

MATERIALS and METHOD

Materials

Twenty respondents participate as control and treatment group. The research uses toothpaste containing non enzyme and enzyme. Both have equal fluoride contents. Unit analysis is Streptococcus mutans from plaque.

Cariostat⁶ a calorimeter containing 2 ml blue to purple liquid in a tube to detect caries activity.

Method of Work

Twenty respondents who participate as subject are treated twice a follows. As control group by tooth brushing with dentifrice containing non-enzyme and then as treatment group by tooth brushing with dentifrice containing enzyme. The complete method as follows:

1. Respondents are examine their oral hygiene. Their oral hygiene shall be on the average.
2. Respondents fill and sign informed consent.
3. In the first month, as control group brush their teeth twice a day with non enzyme dentifrice and then in the next one month they brush their teeth with dentifrice containing enzyme as treatment group.
4. Plaque samples are taken before and after brushing with dentifrice containing non-enzyme and with enzyme. Plaque samples are taken by excavator from small areas of buccal upper and lower molar teeth surface.

\[
\begin{align*}
\text{Maltose} & \xrightarrow{\text{Amiloglucosidase}} 2 \text{glucose} \\
\text{Glucose + O}_2 + \text{H}_2\text{O}_2 & \xrightarrow{\text{Glucoseoxidase}} \text{Glukonolakton} + \text{H}_2\text{O}_2 \\
\text{SCN}^- + \text{H}_2\text{O}_2 & \xrightarrow{\text{Lactoperoxidase}} \text{OSCN}^- + \text{H}_2\text{O}
\end{align*}
\]

With this system, OSCN- as inhibitor is always available and it can be absorbed into plaque easily. The inhibitor will make glycolytic enzymes of EMP on \textit{Streptococcus mutans} cell wall, inactive and glycolysis in \textit{Streptococcus mutans} will be blocked consequently. Without glycolysis acid production of cariogenic microorganism is inhibited.

It is known that fluoride which is assumed to be able to inactive ring of enzyme lactoperoxidase, has no effect in high SCN concentration. And so fluoride ion do not have influence upon LPO system. But fluoride can reduce acid synthesis of the microorganism, and combination fluoride and dentifrice containing enzyme AG and GO will give best results.

**CONCLUSION**

Tooth brushing with dentifrice containing enzyme will decreases caries activity of mutans streptococci in plaque. It is expected that, it can be used to prevent caries risk.
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LITERATURE REFERENCES


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