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Research Report

The effectivity of cavity cleanser chlorhexidine gluconate 2% and saponin 0.78% of mangosteen peel

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ABSTRACT

Background: Use of cavity cleanser is important before restoration the teeth to clean debris, residue of prepared dentine, blood, bacteria, collagen denaturated by teeth preparation. Nowadays, the cavity cleanser that people used still having shortcoming, one of which is the lack of ability to clean the root canal of the smear layer. **Purpose:** The purpose of this study examines the difference of cavity cleaner between saponin of mangosteen peel (*Garcinia Mangostana L.*) and chlorhexidine gluconate 2%. **Methods:** Eighteen upper first premolar divided into 3 groups, each of them consist three tooth. Forming the preparation tooth cavity then group 1 using aquadest for control group, group 2 using chlorhexidine gluconate 2%, and group 3 using saponin of mangosteen peel (*Garcinia Mangostana L.*). For rating cleanliness of the tooth cavity using a scale of cleanliness conducted under Scanning Electron Microscope. **Results:** There was a significant difference ($p < 0.05$) in One-Way ANOVA parametric test and pos hoc test between chlorhexidine gluconate 2 % and saponin of mangosteen peel to the cleanliness of the tooth cavity. **Conclusion:** According to the result of the study, it can be concluded that saponin of mangosteen peel (*Garcinia Mangostana L.*) less effective for cleaning the tooth cavity than chlorhexidine gluconate 2%.

Keywords: *Garcinia Mangostana Linn*; Chlorhexidine gluconate; cavity cleanser; smear layer

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INTRODUCTION

Dental cavity preparation is a restoration procedure to remove infected dentin and make space for the restoration material. The success of the procedure depends on the effectiveness of removing the infected dentin before it is performed. After removing caries in the dentin, it is necessary to remove the remaining bacteria that may be present in the cavity wall, i.e. in the smear layer that is formed, junctional enamel-dentine, or in the dentinal tubules².

One of the ingredients that can be used as a dental cavity cleaner is chlorhexidine gluconate (CHX). Chlorhexidine gluconate has been widely used as a disinfectant in dentin to reduce the number of bacteria³. Chlorhexidine gluconate binds to amino acids present in dentin and kills bacteria within a few hours, so chlorhexidine gluconate is a good antibacterial ingredient. The use of chlorhexidine gluconate as a disinfectant from dental cavities after dental preparation can help reduce the potential for secondary caries and increase tooth sensitivity⁴.

One of the natural ingredients which is considered to have potential as a cavity cleaning agent is *Garcinia mangostana*

Linn which is commonly known as the 'Mangosteen' fruit. Mangosteen peel extract contains saponin which is a strong active compound and gives rise to foam when rubbed in water thus it is a soap and has antibacterial ability⁵.

Saponins, with an active surface, are able to form foam and can increase water penetration⁶. Saponin is an active ingredient of mangosteen (*Garcinia Mangostana L.*) which is characterized by its ability as a surfactant which means it can function as a solvent for impurities and fats. The use of surfactants is divided into three groups, namely as a wetting agent, emulsifying agent and solubilizing agent⁷. Based on this background, the writers are interested in examining the effectiveness of cavity cleaning power between 2% chlorhexidine gluconate and mangosteen skin saponins.

MATERIALS AND METHODS

This type of study was an experimental laboratory study with The Post Test Only Control Group Design study design. The ingredients used were mangosteen skin extract saponins with a concentration of 0.78% and chlorhexidine gluconate 2%. The sample used was the maxillary first premolar with

criteria that the crown was still intact, no caries, had not been restored, and had no fracture. The study was conducted at the Laboratory of Characterization Division of the ITS Metallurgical Materials Faculty.

Mangosteen skin extract saponins were obtained from the maceration process of saponin isolation from mangosteen skin extracts. This study used 18 teeth which were grouped into 3 groups: control group, 2% chlorhexidine gluconate, and mangosteen skin extract saponins. Next, the teeth were fixed, cut in occlusal, prepared using bur wheels with a depth of 1.5 mm, applied by using microbrush with aquadest as a control, 2% chlorhexidine gluconate, and extraction mangon. After that it was irrigated by using a needle and syring with distilled water as much as 1 cc for. The photomicrograph assessment was performed with a Scanning Electron Microscope after coating on 18 which had been irrigated. Assessment by Scanning Electron Microscope (SEM) used the following score⁸: Score 1: 75-100% of open dentinal tubules; Score 2: 50-75% of open dentinal tubules; Score 3: 25-50% of open dentinal tubules; Score 4: <25% of open dentinal tubules.

RESULTS

The assessment was conducted by 3 observers on 3 treatment groups irrigated with distilled water as a control, mangosteen skin extract saponins, and 2% chlorhexidine gluconate. Hence, the results obtained in accordance with Table 1.

In the distilled water cavity cleanser, an average rating of 0.2%, chlorhexidine gluconate 2% obtained an average rating of 2.94%, and mangosteen skin extract saponins obtained an average rating of 1,003%.

Before calculating the data, Friedman Test was performed to determine the validity of the overall study results. The results obtained with a significance level greater than 0.05 ($p > 0.05$) indicate H_0 was not rejected. It can be concluded that there were no significant differences between the three observers which indicated that the assessment data were valid.

After obtaining valid data from 3 observers in the form of a percent value, the data was included in the assessment score. All three groups obtained the same score which was a score of 4 which was categorized as a dirty state.

Table 1. Average results and standard deviations of dental cavity assessments after polishing with 0.78% saponin mangosteen skin extract and 2% chlorhexidine gluconate

Group	Mean	SD	N
0.78% saponin	0.92	0.5546	6
Chlorhexidine gluconate 2%	3.09	0.531	6
Control (aquadest)	0.16	0.176	6

Furthermore, to find out whether there were differences in each group, the data was processed using the SPSS application. The data processed was the results of the assessment in the form of percent.

The analysis used was One-Way ANOVA statistical test. Previously, the normality test was done first in each group by using One-Sample-Kolmogrov-Smirnov. The normality test results obtained a significance value of 0.454 which means greater than 0.05 ($p > 0.05$). This means that the group's data was normally distributed. Then the data homogeneity analysis was tested and the significance value of 0.272 was obtained which was greater than 0.05 ($p > 0.05$). These results indicated that the data variant was homogeneous thus it fulfilled the requirements for continued analysis by using One-Way ANOVA parametric test. Based on the results of statistical analysis, it was found that $p < 0.05$, which is $p = 0.000$ which means there was a significant difference between the groups tested as a whole.

Then, proceed with the Post Hoc test to see which variables have significant differences. There was a significant difference between the control group and Chlorhexidine gluconate 2% and between Chlorhexidine gluconate 2% and saponin ($p < 0.05$). There were no significant differences ($p > 0.05$) in the control group and saponin. It can be concluded that Chlorhexidine gluconate was 2% better when compared to mangosteen skin extract saponins in cleaning tooth cavity.

DISCUSSION

Dentin is a network consisting of organic and inorganic components. The inorganic component is approximately 60% consisting of apatite hydroxy: $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$, 30% organic component, and 10% water. There are 90% of the organic material is collagen and the rest consists of non-collagenous components such as phospho-protein, proteoglycans, g-carboxy-glutamate containing protein (eg gla-protein), glycoprotein acid, and lipids⁹. Dentin is more heterogeneous, has less inorganic content, and more water content than enamel. The complex structure of the dentin complicates the bonding of composite-resin (lift) bond. A smear layer will be formed which will reduce bond strength in tooth cavities that have been prepared. Therefore, it is necessary to clean the cavity to remove the smear layer that is formed¹⁰.

Cameron and Madder in 1983 described the formation of two types of smear layers: the first consists of a superficial layer attached to the dentin wall and the second of the smear material contained in the dentinal tubules. The depth of the smear layer contained within the dentinal tubules or smear plug varies. According to the hypothesis proposed by Cengiz in 1990, the penetration of material into the dentinal tubules may be caused by capillary action as a result of the adhesive strength between the tubules and the smear layer¹¹.

This study examines the effectiveness of mangosteen peel extract saponin and chlorhexidine gluconate 2% on the cleanliness of the dental cavity from the smear layer.

Previous preliminary studies were conducted with the results of dilution of saponins, such as 100%, 50%, 25%, 12.5%, 6.25%, 3.125%, 1.56%, 0.78% where the best 0.78% concentration in cleaning cavities of teeth from the smear layer. Smear layer is used as an indicator of cleanliness of dental cavities because each preparation process will produce a smear layer. The effectiveness of 0.78% saponin extract of mangosteen peel and 2% chlorhexidine gluconate can be determined by conducting in vitro research and seen using a scanning electron microscope or SEM. By using SEM, it can be known whether or not the dentinal tubules are open. The more open dentinal tubules, the cleaner the cavities of the teeth¹².

Based on the results of the study using assessment criteria⁸ that 0.78% saponin and 2% chlorhexidine gluconate get a score of 4 (<25% open dentinal tubules) which means that both 0.78% saponin and 2% chlorhexidine gluconate are not effective in cleaning cavities. In both groups, the dentin smear layer can be lifted however the debris tag contained in the dentinal tubules or so-called smear plug cannot be removed either by saponins or chlorhexidine gluconate 2%. Based on the results of statistical calculations with the post hoc test, it is known that there are significant differences in the material being tested. The group reviewed with chlorhexidine gluconate 2% was better when compared with 0.78% saponin mangosteen skin extract.

Chlorhexidine gluconate 2% could not completely clean the smear layer in a cavitic cleansing study, the smear plug could not disappear so it did not open the dentinal tubules, although dirt on the surface of the dentin could be lifted. Chlorhexidine gluconate is used as a cavity cleanser because of its proven antibacterial properties. Previous studies have shown that the application of Chlorhexidine gluconate as a cleaning agent after acid-etching does not have a direct effect on the bond strength between composites and dentin. The 2% chlorhexidine gluconate activity predominates on its antibacterial properties which kills bacteria by damaging bacterial cell walls. Chlorhexidine gluconate 2% is a positively charged hydrophobic and lipophilic molecule that can interact with phospholipids and lipopolysaccharides on bacterial cell membranes resulting in an increase in permeability of bacterial cell walls. This allows chlorhexidine gluconate 2% to penetrate into bacteria and kill bacteria. Chlorhexidine gluconate 2% has no tissue dissolving activity is not effective enough in removing the smear layer, and cannot inhibit biofilms¹³.

In a study conducted by Deavita, 2013 on the effectiveness of mangosteen peel extract and 2% chlorhexidine gluconate on root canal cleanliness showed that mangosteen peel extract was effective in cleaning root canals, seen from the opening of root canal dentine tubules. That is because the mangosteen peel extract contains saponins that are as surfactants. This study can be showed that in tooth cavities that have been prepared, even though superficial impurities in the cavity walls are lifted, mangosteen peel extract saponins cannot clean the tooth cavity from the smear layer optimally. It can be seen through not lifting the smear plug hence the dentinal tubules are not open. This

is influenced by several factors, one of which is due to the different structure of each saponin. Saponins derived from plants generally have one, two, or three sugar chains that are attached to aglycones or sapogenins. Saponins with two or three sugar chains will decrease the foaming ability of saponins and in some saponins can eliminate foaming abilities. The concentration of saponins also influences the nature of saponins in a solution in the form of water saponin in groups form micelle and show critical micelle concentration (CMC). The molecules do not aggregate with concentrations below CMC, on the other hand, when concentrations exceed CMC and solutes begin to form micelles, there is a sudden change in the physical properties of saponins. The shape of the micelles in aqueous solution, their size and structure depends on the type of saponin. For instance, the saponin from soybean forms a small micelle consisting of two molecules, while the saponin from *Quillaya saponaria* consists of 50 molecules and appears to be significantly less hydrated¹⁴.

Saponins contain carboxylic acids in their chemical structure. The presence of carboxylic acids in the saponin molecule greatly influences surface activity. Not only is the presence or absence of carboxylic acids, but also the location in molecules is very important. This can be proven from the results of research from Kjellin who examined the structure of saponins from soybeans commonly called soyasaponin I and monodesmosodic saponins from *Sapindus mukurossi*. There is a carboxyl group in Soyasaponin I, the hydrophilic sugar chain. Carboxylic groups dissociate in the aqueous phase and form free carboxyl anions which increase the solubility of molecules in water. In contrast, saponins from *Sapindus mukurossi* contain carboxylic groups which are bound to have an aglycone portion of the molecule which is hydrophobic, and the decomposition ability of these carboxylic groups is very low. This difference in surface activity causes lower surface and surface tension in Saponin *sapindus* compared with soyasaponin I¹⁴. Until now, there has been no further study on the structure of mangosteen peel saponins so it is difficult to determine the type of saponin from mangosteen peel.

15 CONCLUSION

Based on the results of this study, it can be concluded that mangosteen peel extract saponins (*Garcinia mangostana* Linn) are not effective in cleaning tooth cavity compared with 2% chlorhexidine gluconate. For further study is needed on effective saponin doses in clearing the root canals as well as further research on the structure of saponins from mangosteen peels.

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