AN ANALYSIS OF ENAMEL REMINERALIZATION IN EGGSHELL USING Energy Dispersive X-Ray Spectroscopy (EDS)

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ABSTRACT
Aim or purpose: Many patients suffer from sensitive teeth after bleaching that can cause demineralization of enamel and widening of dentinal tubules. Therefore, researchers are looking for alternative materials for use as a dental enamel remineralization ingredients include chicken egg shells containing calcium carbonate that can restore lost inorganic compounds. This study aimed to analyze the remineralization of tooth enamel using chicken egg shells gel after bleaching.

Materials and methods: This study was a laboratory experimental research design with the post test only control group design. The research sample was five maxillary central incisor that has been applied materials 35% hydrogen peroxide bleaching at different time range is 1 hour, 1 hour 30 minutes, 2 hours, 2 hours 30 minutes and 3 hours. After the gel is applied samples of chicken egg shells for 14 consecutive days. Analysis remineralization of tooth enamel was analyzed using Energy Dispersive X-ray Spectroscopy (EDS). Analysis of data using non-parametric test (Kruskal Wallis).

Results: The results of this study, obtained p-value = 0.987 (p <0.05; significant) which means tooth remineralization gel made from chicken egg shells not cause a significant difference in the average content of tooth enamel elements between the control group and the group receiving treatment gel application of chicken egg shells.

Conclusions: It can be concluded egg shells gel can not increase the remineralization of tooth enamel.

Keywords: eggshells gel, remineralization, bleaching

INTRODUCTION

Today, the appearance is one thing that the public is concerned, especially those working in the field of entertainment, such as models, movie stars and singers as well as those who work in fields that require the appearance of a newsreader, teachers or pramugari.1,2 White teeth is one of the things that support in terms of appearance. Teeth whitening or better known as dental bleaching is a whitening procedure that is commonly performed to restore the color of the teeth to near original color of teeth with a chemical substance whose primary goal is to restore function estetik. There are several kinds of teeth whitening ingredients that
have been used such as sodium hypochlorite, sodium perborate and hydrogen peroxide. Tooth whitening material most often used is hydrogen peroxide 35%. Hydrogen peroxide is a compound of a clear, colorless, odorless and non-flammable. Research conducted by Miranda et al (2005) showed a change in the structure of enamel after bleaching treatment in the form of tooth erosion. Haywood et al also reported 55-75% of patients whose teeth after whitening treatments experienced tooth sensitivity due to enamel demineralization and widening dentinal tubules. Demineralization caused by binding of calcium release from hydroxyapatite compound tooth enamel due to changes in the microstructure of the Boksman (2006) revealed that the concentrations of the material and the length of tooth whitening teeth are exposed to greater risk of tooth sensitivity. At this time, many of the ingredients are produced which can enhance remineralization process. Besides fluorine, CPP-ACP (Casein Phosphopeptide-Amorphous Calcium Phosphate), it turns out chicken egg shells can also enhance remineralization process tersebut.\(^2\)\(^3\)

Eggshell is a source of CaCO\(_3\) (calcium carbonate) greatest levels reaching 95%. One of the alternatives that can be done to address the eggshell is by treating eggshells into powder hydroxyapatite. Hydroxyapatite is a term used to describe a bond containing calcium ions that can be combined with the orthophosphates, pyrophosphates, hydrogen or hydroxide which is a key ingredient in the formation of bone and tooth enamel, so called biomaterial.\(^3\)\(^4\) The main composition of eggshell is calcite, the crystalline form of calcium carbonate (CaCO\(_3\)). Average weight of an eggshell is about 5 grams and 40% calcium. Based on the results of the study, chicken egg shell powder containing calcium at 401 ± 7.2 grams, or about 39% of calcium in the form of calcium carbonate. There is also a strontium at 372 ± 161μg, toxic substances such as lead (Pb), Aluminum (Al), Cadmium (Cd) and Mercury (Hg) contained in small amounts, as well as with Beryllium (B), Iron (Fe), Vanadium (V), Zinc (Zn), Phosphorus (P), Magnesium (Mg), Fluorine (F), Selenium (Se), Copper (Cu) and Chronium (Cr).\(^5\)

The presence of calcium oxide (CaO) is high on chicken egg shells is expected remineralization may occur. For that the CaO in the chicken egg shells is expected to enhance the remineralization process. To see remineralization, the instrument that will be used is an Energy Dispersive X-ray Spectroscopy (EDS) for EDS has advantages determining elements in samples ranging from beryllium to uranium can be detected. Based on the description above, the writer interested to know the remineralization of tooth enamel after application of
chicken egg shells gel using EDS. The purpose of this study was to analyze the remineralization enamel teeth after bleaching gels chicken egg shells.\(^5\)

**MATERIALS AND METHODS**

This type of research is a laboratory experimental design with penelititan the post test only control group design. This research was conducted at the Laboratory of Microstructures Faculty of Science, University of Makassar. The sample used is the maxillary central incisors man who has been extracted at the dentist.

Synthesis of hydroxyapatite from chicken egg shells begins with calcination chicken egg shell powder at a temperature of 1000°C for 5 hours. CaO calcination results in suspend in 1000 ml of distilled water with a concentration of calcium (Ca) 0.5 M. Thereafter, a solution of (NH\(_4\))\(_2\) \(\text{HPO}_4\) 0.3m as much as 100 ml put dropwise into the suspension CaO at a temperature of 40 ° C while the solution was stirred using a magnetic stirrer and left for 5 hours. Subsequently, sintering is done to dry the precipitate to obtain a compound CA10 (PO 4) 6 (OH 2) at a temperature of 800°C for 1 jam.\(^6\)

Making chicken egg shells gel starting with 0.4 g carbopol entering into a mortar, then added 9.82 ml of distilled water was stirred rapidly until terbetuk clear solution, then added a solution of NaOH 10% as much as 0:56 ml stirred slowly that shaped gel-like mass. 0:02 nipagin g dissolved in ethanol 96% sebanya 0.1 g and put into basisi gel. 2.8 g of hydroxyapatite powder incorporated into the telha basisi gel and stirred until homogen.\(^7\)

Preparation of the five elements of new samples extracted teeth stored in saline so that the condition of the teeth are not damaged. Clean the tooth crown of calculus, debris using pumice. Tooth sample was rinsed under running water and performed twice. Download your teeth using tweezers and blow drying with the use of water. After drying the sample tooth in drain and cut using carborundum disc in the area semente enamel junction with a size of 3x3 mm. Samples are then applied in the form of hydrogen peroxide bleaching materials 35% with a range of 1 hour, 1 hour 30 minutes, 2 hours, 2 hours 30 minutes and 3 hours. After which the samples were washed using normal saline solution for applying gel chicken egg shells. The samples were then smeared gel chicken egg shells for fourteen days in which the application is done every 24 hours and rinsed with a saline solution. On day fourteen, the sample was washed using saline solution to clean in preparation for analysis using EDS (Energy Dispersive X-Ray Spectroscopy)
RESULT

Observations compounds contained in tooth enamel is done by means of Energy-Dispersive X-Ray Spectroscopy (EDS) after application of the gel shell chicken eggs shows the results in the form of graphs. The graph consists of charts with the application of gel shell eggs that have previously been applied to hydrogen peroxide bleaching materials 35% for 1 hour, 1 hour 30 minutes, 2 hours, 2 hours 30 minutes and 3 hours. (Figure 1)

Figure 1. X-ray diffraction pattern of tooth enamel after application of chicken egg shells gel for 1 hour.

Figure 2. X-ray diffraction pattern of tooth enamel after application of chicken egg shells gel for 1 hour 30
Figure 3. X-ray diffraction pattern of tooth enamel after application of chicken egg shells gel for 2 hours.

Figure 4. X-ray diffraction pattern of tooth enamel after application of chicken egg shells gel for 2 hours 30 minutes.
Figure 5. X-ray diffraction pattern of tooth enamel after application of chicken egg shells gel for 3 hours.

Table 1. The results mean inorganic compounds on the surface of the tooth enamel after application of the gel of chicken egg shells

<table>
<thead>
<tr>
<th>Enamel Compounds</th>
<th>EDS</th>
<th>Comparative test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>p-value</td>
</tr>
<tr>
<td>Oxygen</td>
<td>14,292 ± 0,26224</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>0,358 ± 0,070143</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>3,302 ± 0,060992</td>
<td></td>
</tr>
<tr>
<td>Phosphorus</td>
<td>2,11 ± 0,4062</td>
<td>0,987</td>
</tr>
<tr>
<td>Potassium</td>
<td>0,135 ± 0,007071</td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td>3,764 ± 6,253326</td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td>0,4 ± 0,007071</td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td>0,14 ± 0,01</td>
<td></td>
</tr>
</tbody>
</table>

Based on the results table test analysis non parametric (test Kruskal), it can be seen that the average composition of the oxygen of each treatment was 14.292, the average composition of sodium from each treatment was 0.358, the average composition of calcium from each treatment was 3.302, average -rata phosphorus composition of each treatment was 2.11, the average composition Pottasium of each treatment was 0.135, the average composition of each treatment Magnesium is 3,764, average composition of Aluminium of each treatment was 0.4, the average composition of Chlorine of each treatment was 0.14 statistical test results obtained P = 0.987> 0.05 which means that Ho (the null hypothesis) is received, which means there is no effect. This means that the "treatment gel application chicken egg shells on the surface of the tooth enamel does not have a significant influence on the enamel surface of the tooth"
Table 2. Differences in the composition of dental enamel after application of chicken egg shells gel previously demineralized using Hydrogen Peroxide 35%.

<table>
<thead>
<tr>
<th>Komposisi enamel</th>
<th>Group</th>
<th>Oxygen</th>
<th>Sodium</th>
<th>Calcium</th>
<th>Phosphorus</th>
<th>Pottasium</th>
<th>Chlorine</th>
<th>Magnesium</th>
<th>Hasil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hidrogen 1</td>
<td>15,78</td>
<td>1,31</td>
<td>3,39</td>
<td>2,13</td>
<td>1,13</td>
<td>2,15</td>
<td>1,16</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hidrogen 1</td>
<td>15,10</td>
<td>1,47</td>
<td>3,39</td>
<td>3,19</td>
<td>3,14</td>
<td>0,13</td>
<td>0,21</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>hour 30 minute</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hidrogen</td>
<td>15,29</td>
<td>0,35</td>
<td>3,27</td>
<td>3,29</td>
<td>2,11</td>
<td>0,13</td>
<td>0,15</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hidrogen</td>
<td>12,94</td>
<td>0,28</td>
<td>3,13</td>
<td>2,1</td>
<td>3,28</td>
<td>0,15</td>
<td>0,18</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>hour 30 minute</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hidrogen</td>
<td>11,27</td>
<td>0,26</td>
<td>3,33</td>
<td>1,09</td>
<td>-</td>
<td>0,14</td>
<td>0,15</td>
<td>Not signifikan</td>
</tr>
<tr>
<td></td>
<td>hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Table 2 shows that the composition of the enamel from the Energy-Dispersive X-Ray Spectroscopy (EDS).Compound content of tooth enamel after the gel was applied chicken egg shells changes in the samples that had previously been in the demineralization using Hydrogen Peroxide 35% in the range of 1 hour and 1 hour 30 minutes which is marked by the increasing value of the compound Oxygen, Sodium, Sodium, Calcium, potassium, chlorine, magnesium, except on the application in the range of 3 hours and chlorine compounds have been no changes.
DISCUSSION

This study is an experimental laboratory which aims to analyze the remineralization of tooth enamel after topical gel chicken egg shells by using Energy Dispersive X-ray Spectroscopy (EDS). The sample used in this study was 5 the central incisors of the upper jaw had previously been applied materials bleaching menggunakan hydrogen peroxide 35% with a range of different time is 1 hour, 1 hour 30 minutes, 2 hours, 2 hours 30 minutes and 3 hours. After that, the samples are applied using chicken egg shells gel for 14 days, conducted over 14 days for the remineralization process is expected to occur on a day to 14.8,9

The composition of calcium compounds in the sample gel smeared chicken egg shells that had previously been in demineralized using 35% hydrogen peroxide for 1 hour. The composition of inorganic compounds in each sample contained calcium, sodium, oxygen, phosphorus, Pottasium, Mangnesium, aluminum and chlorine with different percentage value. This occurs because each component of the inorganic experiencing precipitation is spontaneous in agent remineralization (gel chicken egg shells), because there are several compounds that are insoluble in water, such as phosphate, while calcium is the class of alkaline soils are less reactive and difficult to dissolve as well as differences in the thickness of the anatomical of each tooth enamel that causes the penetration of different inorganic components. This is in synergy with the research conducted by Jario Mariel Cardenas et al (2014) showed that the thickness of the enamel affects the penetration of components anorganik.7

Remineralization can occur if the pH is neutral, there are Ca2 + and PO43- enough on the environment. Calcium and phosphate ions will hinder the process of decomposition of hydroxyapatite and causes rebuilding or reconstruction partially soluble crystalline hydroxyapatite. Microporosity which are caused by acid etching resulting in tooth enamel has a high surface tension energy so as to allow the minerals calcium and phosphorus into the microporosity tersebut.10 Remineralization is the natural repair process to restore lost minerals in ionic form hydroxyapatite mineral, it leads to loss of ion calcium, phosphate and fluoride ions which will be replaced with Fluorapatite. Ion is more resistant to acids so that a more favorable tooth enamel surface. Therefore apatite crystals in enamel surface that has tereminalisasi more resistant to organic acids. This lasted until the oral pH back to normal. Conversely when the pH in the oral cavity increases, calcium, minerals, phosphate and fluoride ions in the form Fluorapatite will return to the tooth structure to blend and form a
hexagonal crystal larger. This is also consistent conducted by Bejoy Mony et al (2015) stated that the high pH and calcium has potential as an ingredient remineralisasi.\textsuperscript{11,15}

Ions of calcium and phosphorus will increase the degree of saturation of the hydroxyapatite. The degree of saturation is affected by the concentration of calcium in the enamel surrounding environment. The higher the concentration of calcium and phosphorus in the environment, the degree of saturation will increasing.\textsuperscript{9} Concentration of calcium and phosphates will result in rapid precipitation of the minerals calcium and phosphate in the enamel microporosity. Precipitation of calcium and phosphate mineral will result in the closure of microporosity enamel and this is what is referred to as remineralization enamel.\textsuperscript{12,13}

In this study used natural materials, namely tooth remineralization gel made from chicken egg shells so as not to cause a significant difference in the average content of tooth enamel elements between the control group and the group receiving treatment gel application chicken egg shells.

CONCLUSION
There is an increasing number of inorganic compounds in samples that had been smeared with a gel of chicken egg shells such as Calcium, Phosphorus, Mangnesium, chlorine, oxygen, phosphorus and aluminum are instrumental in maintaining the crystal growth of tooth enamel.

REFERENSI


