

## An Analysis of the Compounds of Dental Enamel after Application Strawberry Gel with Energy-Dispersive X-ray Spectroscopy (EDS)

Asmawati<sup>1\*</sup>, Bahruddin Thalib<sup>2</sup>, Nurhayati Natsir<sup>3</sup>, Irene E. Rieuwpassa<sup>1</sup>,  
Alqarama Mahardhika<sup>4</sup>, Rafikah Hasyim<sup>1</sup>

1. Department of Oral Biology, Faculty of Dentistry, Universitas Hasanuddin, Makassar, Indonesia.
2. Department of Prosthodontic, Faculty of Dentistry, Universitas Hasanuddin, Makassar, Indonesia.
3. Department of Conservative, Faculty of Dentistry, Universitas Hasanuddin, Makassar, Indonesia.
4. Oral and Dental Hospital, Universitas Hasanuddin, Makassar, Indonesia.

### Abstract

To analyze compounds of dental enamel after strawberry gel application. This study using six central incisors maxillary that has been extracted. Six central incisors maxillary were divided into five time series, one tooth is used as a control and five tooth given applications of strawberry gel for 1 hour, 1 hour 30 minutes, 2 hours, 2 hours 30 minutes and 3 hours. Then, compounds of dental enamel observed by using Energy-Dispersive X-Ray Spectroscopy. An analysis using non-parametric test (Kruskal Wallis test) to determine differences compounds that occur at each time range. The results of this study,  $p$  value =  $0.406 > 0.05$ . This means there is no significant difference on dental enamel compound between the control group and the group that had been treated with strawberry gel application. There was no significant effect between time duration and changes in mineral compounds of dental enamel after application of strawberry gel.

Clinical article (J Int Dent Med Res 2018; 11(2): pp. 656-662)

**Keywords:** Compound dental enamel, dental bleaching, strawberry gel.

**Received date:** 22 January 2018

**Accept date:** 18 February 2018

### Introduction

In the era of globalization, aesthetics is one thing that the public is concerned, especially those working in the entertainment field such as movie stars, models, singers, and they are very demanding field of work looks like the flight attendant, news readers, and executive marketing.<sup>1</sup>

Tooth discoloration can be derived from various sources of intrinsic and extrinsic. Intrinsic discoloration caused by trauma of the pulp (which produces hemorrhagic) of genetic and congenital disorders (eg, phenylketonuria, congenital hyperbilirubinemia, amelogenesis and dentinogenesis imperfecta) or medications (eg, tetracycline and fluorosis). Meanwhile, extrinsic discoloration only affects the enamel surface.

This occurs because the consuming beverages and foods that contain dyes that are very high, smoking and poor oral hygiene.<sup>2</sup>

Tooth whitening or better known by the term bleaching is a way back tooth whitening discolored tooth to near native colors with the repair process chemically whose main purpose is to restore function to the person's aesthetic. The number of patients who are sensitive to bleaching materials and the high cost to be incurred for treatment makes many researchers both outside and within the country to look for other alternative materials that are safer and cheaper to use as a bleaching material.<sup>1</sup>

Strawberry is one of the natural ingredients that can be used to whitening back teeth that have changed color.<sup>1</sup> Strawberry contain elagat acid and malic acid that can whiten teeth. Part of the strawberry plants can be used to whiten teeth is the fruit and leaves.<sup>2,3</sup> Malic acid is said to be involved in the process of erosion. These acids can bind calcium in dental enamel and cause porosity crystal enamel which have an impact on the occurrence of dental erosion will further lower the surface hardness of teeth.<sup>4</sup>

#### \*Corresponding author:

Asmawati  
Department of Oral Biology  
Faculty of Dentistry, Universitas Hasanuddin  
Makassar Indonesia.  
E-mail: asmaamin281068@gmail.com

Tooth whitening usually raises concerns about the possibility of changes in chemical dental enamel. Some of the bleaching gel is available in a low pH to enhance the microstructural and chemical changes in the dental enamel.<sup>5</sup> Based on the results of measurements of pH on the research that has been done by Suharyanti Suwakbur et al which compares strawberry fruit juice, tomato juice and 10% carbamide peroxide as a dental bleaching agent explained that the strawberry fruit juice has a pH of 3, tomato fruit juice has a pH of 4 and 10% carbamide peroxide has a pH of 6. The results of the measurement of pH in these studies indicate that the pH of strawberry is the lowest pH than other submersion group. From some theories say that the lower the pH of a substance, the more acidic. Dental enamel will erode when it reaches the critical pH of 5.5, which can cause dental enamel solubility resulting in erosion.<sup>6,7</sup> Dental enamel is composed of calcium, phosphorus, oxygen and hydroxyapatite crystals, an in vitro study was conducted to determine what compounds contained in dental enamel after application strawberry gel.<sup>5</sup> Thus, the authors are interested to analyze the content of a compound contained in dental enamel after application strawberry gel.

### Materials and methods

This type of research is an experimental laboratory, the research design is the control time series design. This study was approved by the Ethics Committee of the Faculty of Medicine, University of Hasanuddin No. 966/H4.8.4.5.31/PP36-KOMETIK/2016, Makassar, Indonesia. The sample used in this study is the human maxillary incisors extracted.

Sample preparation in Oral Biology Laboratory, Faculty of Dentistry, University of Hasanuddin. Samples extracted teeth stored in normal saline solution to maintain the condition of teeth to prevent damage. Clean the surface of dental crown of debris, calculus and other debris by using bur brush and pumice. Enter the entire tooth into the receptacle containing aquades. Make as many repetitions twice so that the surface of the teeth to be clean. Take the teeth one by one using tweezers, then dry using a tissue and air blower. After drying, cutting the roots of teeth with a limit Dentoenamel Junction using carborundum disc. Then, cutting dental crowns in sagittal then transversely to obtain a

sample with a size of 3 mm x 3 mm. Then the samples were stored in saline solution for 24 hours. Second, after preparation of samples is done, performed application strawberry gel has been made in chemical and biological laboratories of the Faculty of Mathematics and Natural Sciences, University of Makassar. Samples were selected based on inclusion and exclusion criteria consist of six tooth, where one tooth were used as controls that were not given application of strawberry gel. Then, five teeth were treated time series at the same time applied strawberry gel. The first sample carried out application strawberry gel for 1 hour, a second sample for 1 hour 30 minutes, the third sample for 2 hours, four samples for 2 hours 30 minutes and five samples for 3 hours. After application of each sample, then the sample is cleaned using aquades and then dried. After drying, all samples are kept in a sterile container and then analyzed by using Energy-Dispersive X-Ray Spectroscopy (EDS).

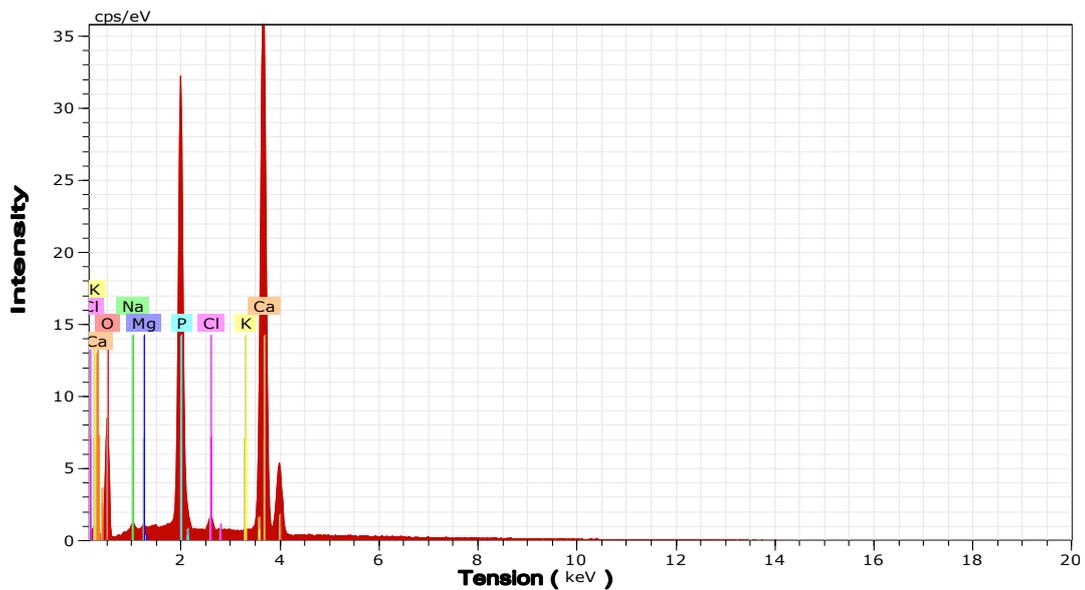
### Results

Observations of the compound found in dental enamel is done by Energy-Dispersive X-Ray Spectroscopy (EDS) after application of the strawberry gel shows the results that can be interpreted on the graph. The graph consists of a control graph, graph with strawberry gel application for 1 hour, 1 hour 30 minutes, 2 hours, 2 hours 30 minutes and 3 hours.

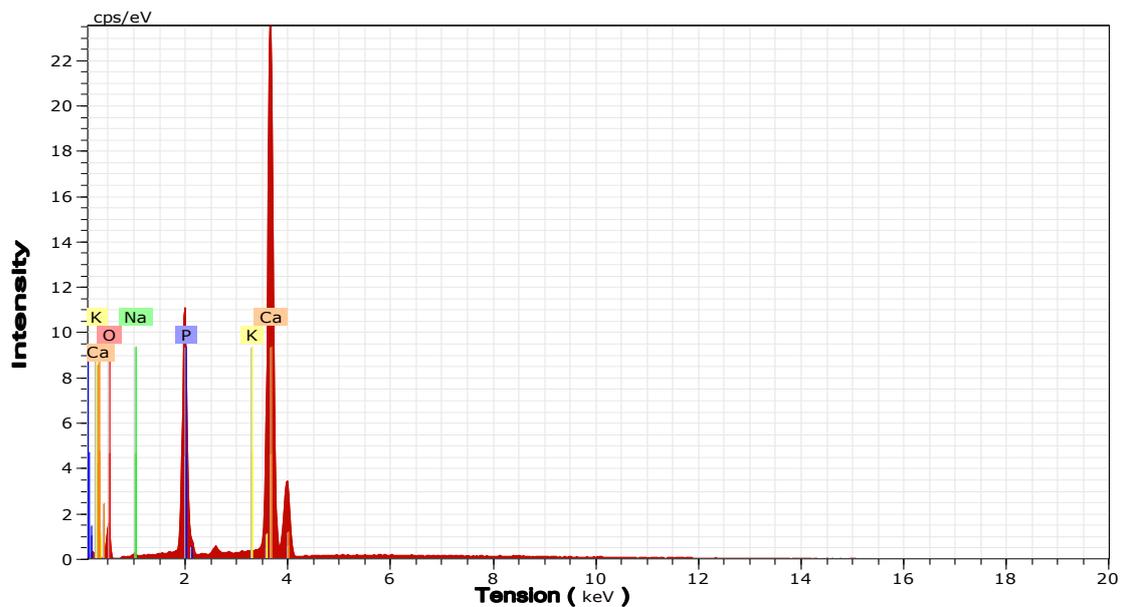
Based on Graph 1 shows that the compounds compiler the sample (control) consisted of 59.89% oxygen, 0.68% sodium, 0.12% magnesium, 13.77%, phosphorus 0.39% chlorine, 0.31% potassium and 24.84% calcium. Graph 2 shows that the compounds compiler the sample that has been applied for 1hour strawberry gel composed of 57.28% oxygen, 0.30% sodium, 9.92% phosphorus, 0.32% potassium and 32.18% calcium. Graph 3 shows that the compounds compiler the sample that has been applied strawberry gel for 1 hour 30 minutes consisted of 59.52% oxygen, 0.24% fluorine, 0.20% sodium, 0.06% magnesium, 0.05% aluminium, 13.19% phosphorus, chlorine 0.26%, 0.35% potassium and 26.14% calcium. In Graph 4 shows that the compounds compiler the sample that has been applied strawberry gel for 2 hours consisted of 57.58% oxygen, 0.02% sodium, 10.30% phosphorus, 0.25% chlorine,

0.06% potassium and 31.79% calcium. Graph 5 shows that the compounds compiler the sample that has been applied strawberry gel for 2 hours 30 minutes consisted of 57.58% oxygen, 1.06% sodium, 0.31% magnesium, 0.23% aluminium, 0.10% silicon 14.05% phosphorus, 0.36% chlorine, 0.33% potassium and 23.39% calcium.

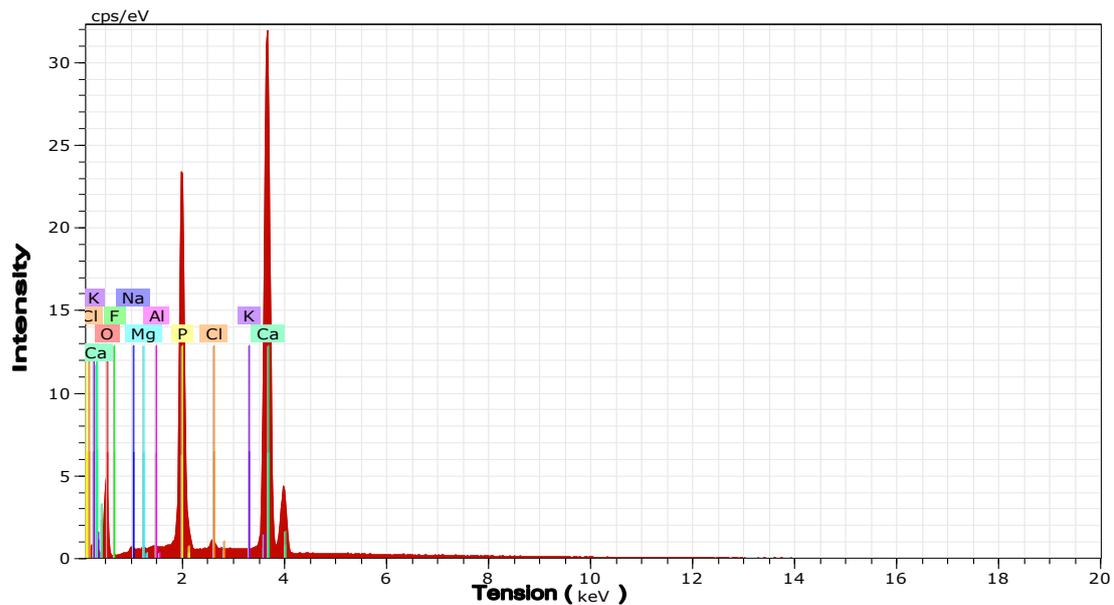
In Graph 6 is seen that the compounds compiler the sample that has been applied strawberry gel for 3 hours consisted of 60.20% oxygen, 2.06% sodium, 0.74% magnesium, 0.40% aluminium, 0.21% silicon, 14.20% phosphorus, 0.12% sulfur, 0.32% chlorine, 0.38% potassium, 21.39% calcium.



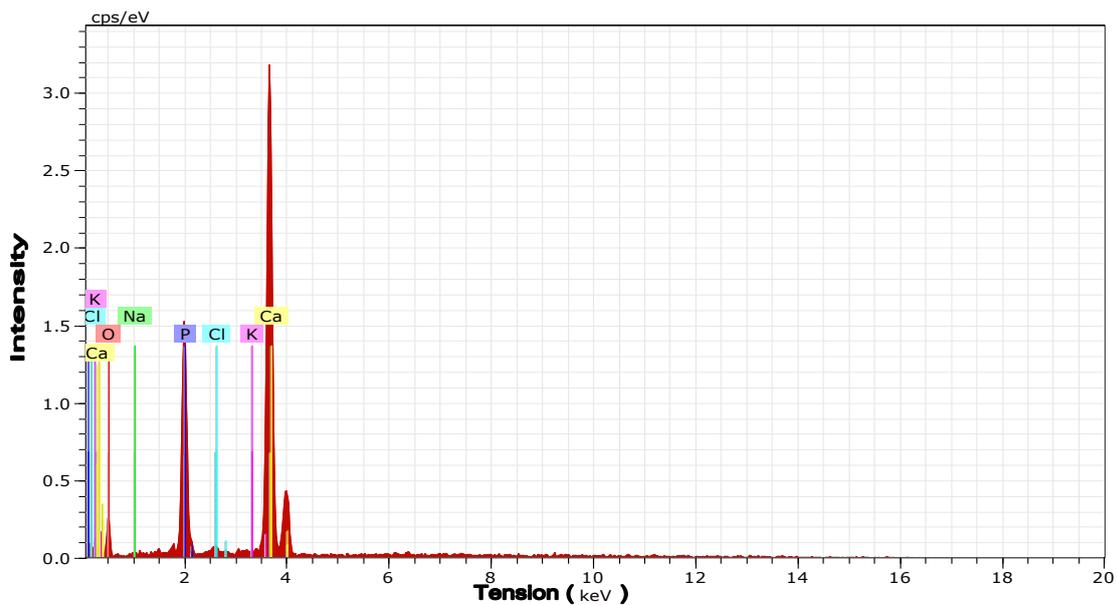
**Graph 1.** X-ray diffraction pattern of dental enamel (control) were soaked with saline solution for 24 hours.



**Graph 2.** X-ray diffraction pattern of dental enamel applied strawberry gel for 1 hour.



**Graph 3.** X-ray diffraction pattern of dental enamel applied strawberry gel for 1 hour 30 minutes

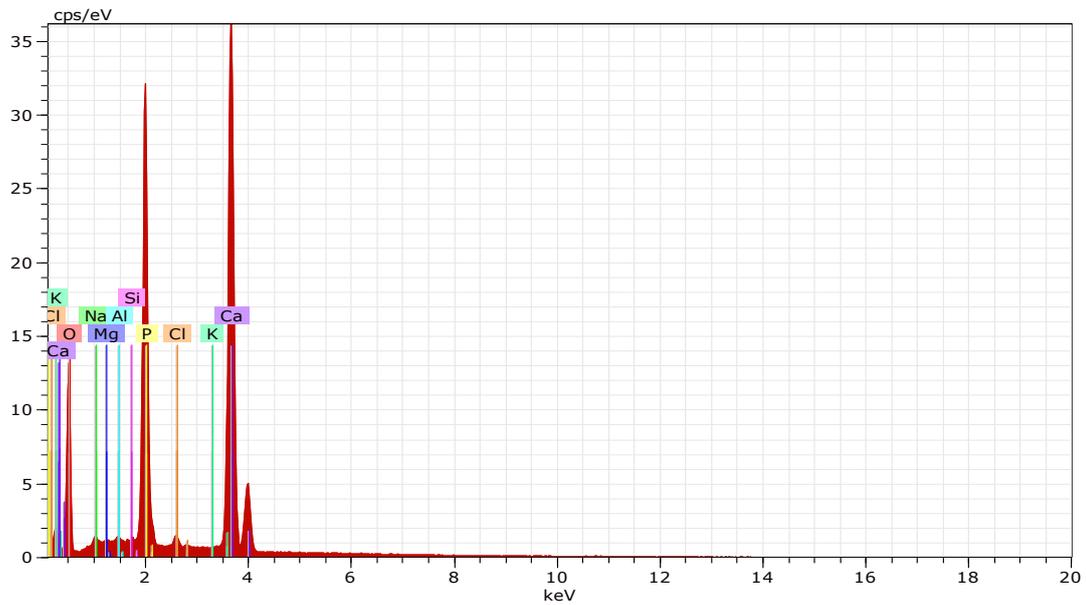


**Graph 4.** X-ray diffraction pattern of dental enamel applied strawberry gel for 2 hours.

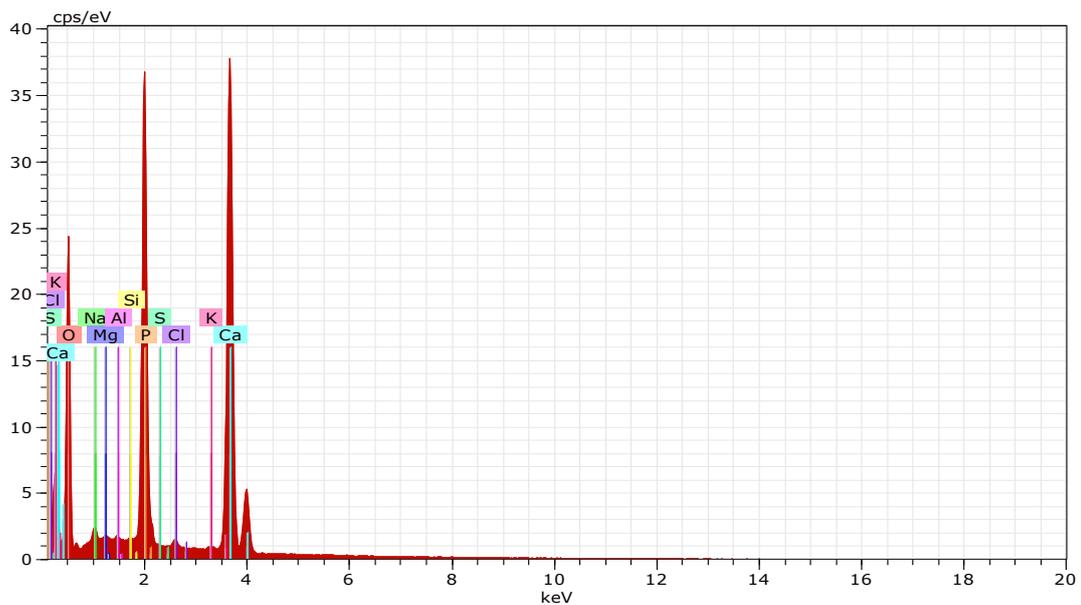
Based on Table 1. The results of the analysis of non-parametric test (Kruskal Wallis test), it can be seen that the average composition of each treatment is oxygen is 15.6550%, average sodium composition of each treatment is 0.2300%, the average composition of calcium from each treatment is 3.3150%, the average composition of phosphorus from each treatment is 1.7350%, the average composition of potassium from each treatment is 0.1333%, the statistical test p value = 0.406 > 0.05, namely Ho

(the null hypothesis) is received, which means treatment applications strawberry gel as tooth bleaching agent do not have a significant impact on the content of dental enamel compound.

Based on Table 2. differences in the composition of dental enamel between the control group and the group treated application strawberry gel, it can be seen there is no significant difference to the compounds found in dental enamel after application strawberry gel.



**Graph 5.** X-ray diffraction pattern of dental enamel applied strawberry gel for 2 hours 30 minutes.



**Graph 6.** X-ray diffraction pattern of dental enamel applied strawberry gel for 3 hours.

Dental Enamel Composition	EDS value <i>Mean ± SD</i>	Normality Test <i>p-value</i>	Comparative test <i>p-value</i>
Oxygen	15.6550 ± 1.81208	0.003	0,406
Sodium	0.2300 ± 0.14199	0.280*	
Calcium	3.3150 ± 0.24809	0.068*	
Phosphorus	1.7350 ± 0.48997	0.087*	
Pottasium	0.1333 ± 0.01366	0.554*	

\*Shapiro-Wilk test:  $p > 0.05$ ; data distribution normal

\*\*Kruskall Wallis test:  $p < 0.05$ ; significant

**Table 1.** Composition of dental enamel from the Energy-Dispersive X-Ray Spectroscopy (EDS).

Group Dental Enamel Composition	Control	Application strawberry gel 1 hour	Application strawberry gel 1 hour 30 minutes	Application strawberry gel 2 hour	Application strawberry gel 2 hour 30 minutes	Application strawberry gel 3 hour	Value
Oxygen	59.89	57.28	59.52	57.58	57.58	60.20	Not Significant
Sodium	0.68	0.30	0.20	0.02	1.06	2.06	Not Significant
Calcium	24.84	32.18	26.14	31.79	23.39	21.39	Not Significant
Phosporus	13.77	9.92	13.19	10.30	14.05	14.20	Not Significant
Pottasium	0.31	0.32	0.35	0.06	0.33	0.38	Not Significant

**Table 2.** Differences in the composition of dental enamel between the control group and the group treated with the application strawberry gel.

## Discussion

This research has been carried out to see if there are changes in the structure of dental enamel after application strawberry gel viewed using Energy-Dispersive X-Ray Spectroscopy (EDS). The sample used in this study is permanent central incisors extracted the six tooth are one tooth were used as controls and five teeth given treatment with application strawberry gel. In the sample used as a control soaking with saline. Saline solution has a neutral pH, which is expected to minimize the effect that the results of the study.

Permanent central incisors were selected for consideration aesthetic reasons, which is the central incisor teeth are on the front representing other anterior tooth are lateral incisors and canines.

In this study, the elements that can be detected in the five samples that had been applied gel strawberry include oxygen, sodium, calcium, phosphorus and potassium. This shows that research using EDS can be used to analyze qualitatively. EDS is an ideal system to present all the data of X-ray of a specimen and can be obtained by analysis of both qualitative and quantitative.<sup>9</sup>

Pizani et al., and Elfallah et al., reported that tooth whitening is usually raises concerns about the possibility of chemical changes that occur in dental enamel, especially on large diffusivity peroxide applied in high concentrations.<sup>5</sup> Morphological changes in the dental enamel surface after bleaching treatment can be seen as an increase in surface roughness and erosion.<sup>10</sup> Dental bleaching agents can cause chemical changes in the structure and texture of the superficial dental enamel.<sup>11</sup> Gutknecht et al., reported that in the process of bleaching, the

whitening effect depends on the time duration of the application of the material and the level of activation.<sup>12</sup> Factors such as pH, concentration, exposure time, and frequency of exposure can contribute to the erosion of the tooth enamel, which causes sensitive teeth and cause bleaching of the teeth.<sup>13,14,15,16</sup>

Dental enamel consists of a large number of highly mineralized prism, and hard due to high percentage of the inorganic matrix is 95% made from crystalline hydroxyapatite (calcium phosphate) and with a low percentage of the organic matrix of 0.36 to 2% along with polysaccharides. Dental enamel has a low permeability, but can act as a semi-permeable membrane that allows the diffusion water and ions. The physiologic process in tooth structure can be disrupted by unbalanced condition between protective and pathologic factors.<sup>5,17</sup>

Elfallah et al. have also reported changes in the chemical composition of dental enamel and mineral loss. Investigation of mechanical micro and nano on the enamel was subjected to bleaching agent hydrogen peroxide showed that significantly reduces the hardness and modulus of elasticity of dental enamel.<sup>10</sup> In this study, use of natural materials that dental bleaching gel made from strawberry that does not cause significant difference in the average compound dental enamel between the control group and the group treated application strawberry gel. Applications strawberry gel as dental bleaching agent do not have a significant effect on the change-forming compounds on dental enamel.

## Conclusions

There was no significant effect between time duration and changes in mineral compounds of dental enamel after application of strawberry gel.

## Acknowledgements

The authors wish to thank the Oral Biology Laboratory Faculty of Dentistry, University of Hasanuddin and laboratory chemical, biological and microstructural physics of the Faculty of Mathematics and Natural Sciences, University of Makassar for helping with the laboratory procedures.

## References

1. Margaretha J, Rianti D, Meizarini A. Change Color of Tooth Enamel After Application of Gel of Strawberry And 10% Carbamide Peroxide Gel. *Mat Dent J* 2009;1(1):16-20.
2. D. Florea A, Miha C, Campeanu R, Nicola Benga GH. The Use of Scanning Electron Microscope in Evaluating the Effect of a *Bleaching* Agent on The Email Surface. *Rom J Morphol Embryol* 2009;50(3):435-40.
3. Larasati DM, Firsty KN, Yogiartono M. Effectiveness of Ellagic Acid that Contains in Strawberry for Acrylic Discoloration. *Asia Pac Dent Students J* 2012;3(2):1-9
4. Marcella MA, Wahyudi IA, Puspita RM. Effect of Coffe, Tea, and Milk Consumption on Tooth Surface Hardness (In Vitro Study). *Jurnal Persatuan Dokter Gigi Indonesia* 2014;63(1):15-8.
5. Pizani AMA, Tholt B, Paciornik S, Dias KR, Albuquerque PP, Queiroz CS. Dental Bleaching Agents with Calcium and their Effects on Enamel Microhardness and Morphology. *Braz J Oral Sci* 2015;14(2):54-8.
6. Seow WK, Thong KM. Erosive Effect of Common Beverages on Extracted Premolar Teeth. *Aust Dent J* 2005;50(3):173-5.
7. Adhani R, Widodo, Sukmana BI, Suhartono E. Effect pH on Demineralization Dental Erosion. *Int J Chem Eng Appl* 2015;6(2):138-41.
8. Agustina A, Sutaryono, Nisa AK. Strawberry Extract Gel Formulation (*Fragaria* sp.) with Gelling Agent Carbomer. *Motorik* 2013;8(17):14-22.
9. Fauzyah E, Suwelo SI, Soenawan H. Senyawa Fluoride pada Email Gigi Tetap Muda yang Ditumpat Semen Ionomer Kaca dan Kompomer. *Ind J Dent* 2008;15(3):1-6.
10. Elfallah HM, Bertassoni LE, Charadram N, Rathsam C, Swain MV. Effect of Tooth *Bleaching* Agents on Protein Content and Mechanical properties of Dental Enamel. *Acta Biomaterialia* 2015:1-9.
11. Elossais AA, Bigarella GD, Pereira NR, et al. Correlation between pH and Surface Structural Changes on Human Enamel Submitted to Different Tooth Whitening Agents. *Sc J Dent* 2014;1(1):8-13.
12. Gutknecht N, Franzen R, Meister J, Lukac M, Pirnat S, Zabkar J, et al. A Novel Er:YAG Laser-Assisted Tooth Whitening Method. *J Laser Health Acad* 2011;11(1):1-10.
13. Price RBT, Sedarous M, Hiltz GS. The pH of Tooth Whitening Product. *J Can Dent Assoc* 2000;66(8):421-5.
14. Moncada G, Sepu'iveda D, Elphick K, Contente M, Estay J, Bahamondes V. Effects of Light Activation, Agent Concentration, and Tooth Thickness on Dental Sensitivity after *Bleaching*. *Oper Dent* 2013;38(5):467-76.
15. Kose C, Calixto AL, Bauer JRO, Reis A, Loguercio AD. Comparison of the Effects of In-Office *Bleaching* Times on Whitening and Tooth Sensitivity: A Single Blind, Randomized Clinical Trial. *Oper Dent* 2016;41(2):138-45.
16. Kwon SR, Kurti SR, Oyoyo U, Li Y. Effect of Various Tooth Whitening Modalities on Microhardness, Surface Roughness and Surface Morphology of The Enamel. *Odontology* 2014;2(5):14-20.
17. Amalina R, Soekanto SA, Gunawan HA. Analysis of CPP-ACP Complex in Combination with Propolis to Remineralize Enamel. *J Int Dent Med Res* 2017;10:814-9.