



ICoSI 2020

The 4th International Conference on Sustainability and Innovation

Universitas Muhammadiyah Yogyakarta, 13-14 October 2020

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Date: 22 October 2020

Letter of Notification

Dear Authors: Fransiska Nuning Kusmawati

We are pleased to inform you that your paper (ABS-2618), entitled:

" The Effect Of Rosella Flower Tea Solution Onto Discoloration Of Plate Heat Cured Acrylic Resin Base"

which has been presented at ICoSI 2020 UMY conference on 13-14 October 2020 at Universitas Muhammadiyah Yogyakarta, Yogyakarta, has been reviewed and the scientific committee has decided that the paper of ABS-2618 is qualified for publication in **ICoSI ISBN-Indexed Proceeding**.

Best regards,

Chairperson of ICoSI 2020

Dr. Yeni Rosilawati, SIP, SE, MM

The Effect of Rosella Flower Tea Solution Onto Discoloration of Plate Heat Cured Acrylic Resin Base

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ABSTRACT

Background: The loss of teeth from one's mouth will increase the need for dentures. The denture base used was heat-cured acrylic resin, in Indonesia. Many natural products are offered to the community where these products have many benefits for the body, one of which is rosella flower tea. Rosella flower tea contains natural dyes, anthocyanins, if consumed regularly it can cause discoloration on the acrylic resin plate. **Aim:** This study was to determine the effect of immersing heat-cured acrylic resin in a solution of rosella flower tea (*Hibiscus sabdariffa* L.) on discoloration. **Material and method:** Experimental study with control group pre-test and post-test design. The samples were heat cured acrylic resin plate with N number was 32 and divided into 2 groups, the control groups and the treatment groups. The control group (16 samples) was immersed in distilled water and the treatment groups (16 samples) was immersed in rosella flower tea solution. First, all of the samples 32 samples were immersed for 7 days, dried and performed color changed measurement, then immersed again for additional 7 days, dried and performed color changed measurement. Color changes were measured using the VITA Easyshade device both before and after 7 and after additional 7 days of immersion. **Results:** The result of the Friedman test showed significant color changes in acrylic resin plates in treatment group, especially on the value of chrome. The result of the Mann Whitney test showed that they were significant differences in the heat acrylic resin plate after immersions in distilled water solution and rosella flower tea for 7 days, and after additional 7 days especially in the chrome. **Conclusions:** Immersing heat cured acrylic plates in rosella flower tea has color changes effect, the longer the immersion time, the greater the potential the color changes

Keywords: Heat cured acrylic resin plates, Rosella flower tea, Color changes

1. INTRODUCTION

The base material for dentures consists of various materials, but the material commonly used in Indonesia is acrylic resin. The type of acrylic resin that is often used is hot polymerization acrylic resin because it has the advantage of being harmonious with the surrounding tissue so that it meets the aesthetic factor, it can be coated and re-affixed easily, is relatively lighter, the manufacturing and polishing technique is easy, and the price is relatively cheap. While the drawbacks of acrylic resin are that they break easily when they fall on a hard surface or due to material fatigue due to long use and experience a change in color because they can absorb water or liquid, food scraps or chemicals considering that this type of resin also has porosity properties[1][2]

Porosity in acrylic resin results in the absorption of water or liquids (drinks) and foodstuffs and chemicals

slowly for a certain period of time, this can affect the color change in acrylic resin due to the entry of food or beverage liquids that have been consumed. This color change in acrylic resin can occur due to the habit of consuming solutions containing dyes. The absorption of the dye into the acrylic resin can affect the color of the denture base. One of the beverage ingredients that can affect color change is tea. [2].

Rosella flower (*Hibiscus sabdariffa* L.) has been used by the global community as a herbal medicine, such as in Sudan and South Africa, Indonesia itself which is a country producing roselle flowers also utilizes the properties of these flowers, where the roselle petals are brewed and consumed as tea. also known as red tea. [3] According to Augustine, anthocyanin-rich rosella extract is an effective antioxidant. Studies have also stated that poly-phenolic acids, flavonoids and anthocyanins found in roselle flowers are powerful

antioxidants [4]. According to research by Diansari (2015) states that soaking hot polymerized acrylic resin in roselle flower tea for 1, 3, 5, and 7 days can causes dimensional changes. The duration of soaking is determined by an average person drinking roselle flower tea for 5 minutes three times a day, so the total time to consume rosella flower tea is 15 minutes per day. [5] So that 7 days of immersion is equivalent to 22 months of consumption, and +7 days is equivalent to 44 month of consumption. Because of the differences in the results of previous studies, it is the reason for the researchers to further investigate the effect of immersion of hot polymerized acrylic resin into rosella flower tea solution (*Hibiscus sabdariffa L.*) on color changes.

2. MATERIALS

2.1. Heat-Cured Acrylic Resin

Acrylic resin is a material that is still used in the field of Dentistry. More than 95% of the denture plates are made of acrylic resin material. [6] Acrylic resin is the result of polymerization of acrylate or methacrylic acid or its derivatives, used for the manufacture of medical prostheses as well as restorations and dental equipment. Polymethyl methacrylate is the basic material for acrylic resin in dentistry which is used as a material for making removable denture bases. Acrylic resin is an ethylene derivative which contains a vinyl group in its structural formula. Based on the reaction setting, acrylic resin is divided into chemically polymerized (self-cured) acrylic resin and heat-cured (heat-cured) acrylic resin. Hot polymerization acrylic resin is one of the denture materials which polymerization process by applying heat. [7]. Today most denture bases are made of heat-cured acrylic resin based on polymethyl methacrylate. This material is packaged in a powder and liquid system. The liquid contains non-polymerized methyl methacrylate and the powder contains the pre-polymerized polymethyl methacrylate resin in the form of small grains. Hot polymerized acrylic resin qualifies as an ideal denture base material, because hot polymerized acrylic resin is non-toxic, does not irritate tissue, has good physical and aesthetic properties, is relatively inexpensive, can be repaired, is easy to manipulate and manufacture. However, the disadvantages are that it breaks easily when it falls on a hard surface or is due to material fatigue due to long use and changes in color after some time being used in the mouth and is also easy to porous and easily absorbs fluids, both water and chemicals [8].

One of the physical properties is porosity caused by the evaporation of unreacted monomers and low primary molecular weight, when the resin temperature reaches or exceeds the boiling point of the acrylic resin

material, this results in bubbles that can appear on the surface and / or under the surface of the denture base. Porosity can also come from the incomplete stirring of the powder and liquid components. If the mixing process is not perfect, then during the polymerization process some resin masses will contain more monomers than others, and some parts of the resin mass will contain less monomer. These two things cause the formation of porus. [9] [2]

Acrylic resin material has the property of absorbing water slowly over a period of time. One of the shortcomings of acrylic resin is the diffusion process of liquid into acrylic resin because it not only affects the color stability of acrylic, but also the dynamic and polymeric properties caused by the slow absorption process of liquid over a long period of time. Acrylic resin absorbs relatively little water when placed in an alkaline environment, and vice versa when placed in an acidic environment, acrylic resin absorbs relatively much water. This water absorption ability will usually increase the weight of acrylic by 1.0-2.0% [9] [2].

Heat-cured acrylic resin exhibits good color stability. The discoloration of the acrylic plate can be caused by the ability to absorb liquid in the material and the environment around the denture, so that the absorbed substance can react with the elements in the acrylic resin. Color stability and surface roughness are closely related. This is because surface roughness will affect plaque retention and accumulation of stains in the restoration material. The rougher the surface, the easier it is to accumulate stain and cause discoloration of the restoration material [2]. The discoloration of the acrylic plates is not only caused by immersion in a disinfectant solution, but also by food and beverage consumption factors such as tea, coffee, drinks containing dyes, and fruit juices. [2]. This is due to the accumulation of color pigments on the surface and absorption of the adhesions of the particles. The discoloration of the denture base can be caused by intrinsic factors and extrinsic factors. The intrinsic factor is the chemical change in the material itself, namely the polymerization process that is not perfect, while the extrinsic factor is in the form of an external factor, namely the color change. Extrinsic factors include the habit of consuming beverages such as tea, coffee, wine or other beverages that contain coloring agents. This is due to the accumulation of color pigments on the surface and absorption of the adhesions of the particles[10].

2.2. Rosella Flower Tea

Rosella flowers as shown in Figure 1 have both pistils and pollen so they do not need other flowers to

reproduce. Rosella (*Hibiscus sabdariffa* L.) can live in areas that have a humid and warm climate in tropical and sub-tropical regions. Roselle has advantages compared to other tropical and subtropical plants, namely that it can withstand very cold weather and can live in rooms that have little lighting but the best growth is obtained in open spaces with sunlight. The most nutritious part of the plant is on the petals. Where is the way to consume it by drinking steeping rosella flowers. [11].



Figure1. Rosella flower

Rosella petals contain several chemical compounds needed by the body, namely carotene, riboflavin, anthocyanins, ascorbic acid, niacin, calcium, iron and vitamin C. The human body needs 22 amino acids. Of these 22, 18 of them are fulfilled from rosella flowers. Rosella flowers are widely used to reduce appetite, respiratory problems caused by flu, and discomfort in the stomach. Rosella is used to treat ulcers and inflammation of the skin, burns, canker sores, and herpes zoster infection. [11] The most dominant secondary metabolic compound in red rosella is the presence of anthocyanins that form flavonoids that act as antioxidants. Rosella flavonoids consist of flavonos and anthocyanin pigments. Anthocyanin compounds contain delphinidin-3-siloglucoside, delphinidin-3-glucoside, cyanidin-3-siloglucoside, which are a source of natural dyes found in roselle flower petals and in almost all plants that provide strong colored pigments. While the flavonoids contain gosipetin and mucilage (rhamnogalakuronan, arabinogalactants, arabinan). [9] [11].

Anthocyanin compounds are a source of natural dyes found in roselle flower petals and in almost all plants which provide strong colored pigments and when applied in water will cause red, orange, purple, and blue colors. [9] In addition to producing strong color pigments, anthocyanin compounds are also functions as an antioxidant which is believed to cure degenerative diseases. Antioxidants, known as scavengers, are molecules that can react with free radicals and function to neutralize free radicals [12].

2.3. Discoloration Measurement Tool

Measurement of color change on heat-cured acrylic resin plates in this study using the VITA Easyshade tool, as can be seen in Figure 2. The VITA Easyshade is the newest spectrophotometer used in clinical use. The spectrophotometer is a digital color measuring instrument. This tool is often used for laboratory and research purposes. Over time, the spectrophotometer was made more compact and lightweight so that it could be used for everyday clinical purposes. The spectrophotometer is a tool that consists of 3 principle elements, namely as a light source, a tool for directing light to objects. A spectrophotometer is a tool that measures light in certain waves. Traditionally, spectrophotometers use a diffraction grating and a Charge Couple Device (CCD) line detector. [13]. The software of this instrument is programmed to provide absolute hue, value, chroma / chrome measurement results according to the Munsell color system. [14]

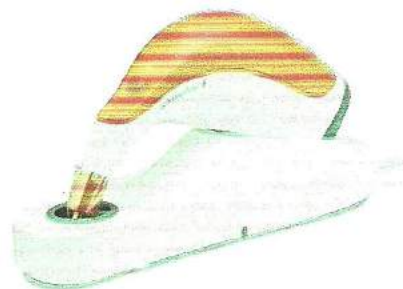


Figure 2. Vita Easy Shade

3. METHODS

The design used was experimental laboratory research. The study was conducted at laboratory room Faculty of Dentistry Prof. Dr. Moestopo (Beragama) in October 2018. 32 samples of heat-cured acrylic resin plates with sample length of 20 mm, width 10 mm, and sample thickness 1 mm. Sampling by simple random sampling.

The work procedure of the research was carried out as follows : (1) Preparing the tools and materials to be used in the study (2) Each sample was cleaned with water and dried with a dry tissue (3) Perform measurement with the Vita Easyshade test on each sample (pre-test) (4) The process of making rosella flower tea solution began by provided 7 petals (\pm 5 grams) of dried flower petals. The roselle petals were infused with 250 ml of boiling water (90°C) for 5 minutes, then the petals were removed and the solution was waited until it reaches room temperature (5) Then it was poured into the 6 ml

plastic container that had been provided (6) Prepare distilled water in a measuring cup as much as 6 ml, then put in a plastic container (7) The samples were divided into 2 groups, which were control and treatment group with 16 samples in each group. Control group was immersed in a plastic container filled with aquadest, while treatment group was immersed in a plastic container that contained rosella flower tea which was already in a 6 ml dose (8) Both control and treatment group samples were measured using digital spectrophotometer (VITA Easyshade) (9) Both samples in control and treatment groups were then immersed within 24 hours for 7 days (assumed for 2 year consumption) and then the samples were rinsed with water, dried with tissue paper and the color changes were recorded using a digital spectrophotometer and named as "after 7 days immersion" (10) The second immersion was then performed for additional 7 days (assumed for 4 year consumption) and then the samples were rinsed with water, dried with tissue paper and the color changes were recorded using a digital spectrophotometer and named as "after additional 7 days immersion" (11) Compare color changes in control group and treatment group and performed data processing presentation and analysis.

4. RESULTS

The aim of this research is to study and explain the effect of immersion time of rosella flower tea on the changes of color plates of heat cured acrylic resin for 7 days and additional 7 days immersion. This research was carried out in an experimental laboratory using 32 samples of cured acrylic resin plate. First group was immersed distilled water as a control group, while the second group was immersed in rosella flower tea as a treatment group. Each groups contains 16 samples. All of the samples were immersed in distilled water and rosella flower tea for 7 days and additional 7 days immersion time. The results of the study can be seen from the following table.

Table 1. Mean Rank of Value Rosella Flower tea

	Mean rank
Value (L) Rosella tea before immersion	2.44
Value (L) Rosella Tea 7 days after immersion	2.16
Value (L) Rosella Tea after add 7 days immersion	1.41

Table 2. Friedman test

N	16
Chi-Square	9.700
Df	2
Asymp.Sig.	.0008

Table 1 showed a difference on the value of value before the study, after 7 days of immersion, and after addition 7 days of immersion. This was supported by the results of the Friedman test (table.2) which showed $p = 0.008$ ($p < 0.05$), which means that there was a statistically significant difference on the value in the acrylic resin plate before the immersion, after 7 days of immersion, and after addition 7 days of immersion rosella flower tea.

Table 3. Mean Rank of Chrome Rosella Flower tea

	Mean Rank
Chrome (C) Rosella tea before immersion	2.88
Chrome (C) Rosella Tea 7 days after immersion	1.97
Chrome (C) Rosella Tea after add 7 days immersion	1.16

Table 4. Friedman test

N	16
Chi-Square	16.484
Df	2
Asymp.Sig.	.0000

Table 3 showed the results of measurements of Chrome that there was a difference in the Chrome values before the study, after 7 days of immersion, and after additional 7 days of immersion. Table 4 also showed the results of the Friedman test which showed the results of $p = 0.000$ ($p < 0.05$), which means that there was a statistically significant difference in the Chrome value in the acrylic resin plate before the immersion, after 7 days of immersion, and after additional 7 days of immersion rosella flower tea.

Table 5. Mean Rank of Value Aquadest

	Mean Rank
Value (L) Aquadest before immersion	2.25
Value (L) Aquadest 7 days after immersion	2.31
Value (L) Aquadest add 7 days after immersion	1.44

Table 6. Friedman test

N	16
Chi-Square	7.871
Df	2
Asymp.Sig.	.0200

Table 5 showed a difference on the value of value before the immersion, after 7 days of immersion, and after additional 7 days of immersion. In table 6, the Friedman test results showed the results of $p = 0.020$ ($p < 0.05$), which means that there was a statistically significant difference on the value in the acrylic resin plate before the immersion, after 7 days of immersion, and additional 7 days of immersion with distilled water.

Table 7. Mean Rank of Chrome Aquadest

	Mean Rank
Chrome (C) Aquadest before immersion	2.78
Chrome (C) Aquadest 7 days after immersion	1.41
Chrome (C) Aquadest after add 7 days immersion	1.81

Table 8. Friedman test

N	16
Chi-Square	16.484
Df	2
Asymp.Sig.	.0000

Table 7 showed a difference in the Chrome values before the immersion, after 7 days of immersion, and after additional 7 days of immersion. Table 8 showed the results of the Friedman test $p = 0.000$ ($p < 0.05$) which means that there is a statistically significant difference in the Chrome value in the acrylic resin plate before the study, after 7 days of immersion, and after additional 7 days of immersion with distilled water.

Table 9. Mann-Whitney result between Aquadest and Rosella Flower tea before immersion

Value (L)	Chrome (C)
Mann-Whitney U 90.500	Mann-WhitneyU 123.500
Wilcoxon W 226.500	Wilcoxon W 259.500
Z -1.416	
Asymp. Sig. (2-tailed) .157	Asymp. Sig. (2-tailed) .865
Exact Sig. [2*(1-tailed Sig.)] .160	Exact Sig. [2*(1-tailed Sig.)] .867

Table 9 showed the results of the Mann-Whitney test on the Value (L) and Chrome (C) values on the acrylic resin plate in the control group with distilled water and the treatment group with rosella flower tea before the immersion. The Mann-Whitney test results for the value (L) showed $p = 0.157$ ($p > 0.05$) and the Mann-Whitney test results for the value (C) showed $p = 0.865$ ($p > 0.05$). Both of these indicated that there was no statistically significant difference in L and C values between the acrylic resin plate in the aquades group and the resin plate in the rosella flower tea group before the immersion.

Table 10. Mann-Whitney result between Aquadest and Rosella Flower tea after 7 days of immersion

Value (L)	Chrome (C)
Mann-Whitney U 122.500	Mann-WhitneyU 30.500
Wilcoxon W 258.500	Wilcoxon W 166.500
Z -207	Z -3.682
Asymp. Sig. (2-tailed) .836	Asymp. Sig. (2-tailed) .000
Exact Sig. [2*(1-tailed Sig.)] .838	Exact Sig. [2*(1-tailed Sig.)] .000

Table 10 showed the results of the Mann-Whitney test on the Value (L) and Chrome (C) values on acrylic resin plates in the control group with distilled water and the treatment group with rosella flower tea after 7 days of the immersion. The Mann-Whitney test results for the value (L) showed $p = 0.836$ ($p > 0.05$) and the Mann-Whitney test results for the value (C) showed $p = 0.00$ ($p < 0.05$). This indicated that there was no statistically significant difference in L value but at C value there was a statistically significant difference between the acrylic resin plate in the aquades group and the resin plate in the rosella flower tea group after additional 7 days of immersion.

Table 11. Mann-Whitney result between Aquadest and Rosella Flower tea after additional 7 days of the immersion

Value (L)	Chrome (C)
Mann-Whitney U 118.000	Mann-WhitneyU 29.500
Wilcoxon W 254.000	Wilcoxon W 166.500
Z -377	Z -3.721
Asymp. Sig. (2-tailed) .706	Asymp. Sig. (2-tailed) .000
Exact Sig. [2*(1-tailed Sig.)] .724	Exact Sig. [2*(1-tailed Sig.)] .000

Table 11 showed the results of the Mann-Whitney test on Value (L) and Chrome (C) on acrylic resin plates in the control group with distilled water and the treatment group with rosella flower tea after additional 7 days of the immersion. In the Mann-Whitney test results for the L value showed $p = 0.706$ ($p > 0.05$) where there was no statistically significant difference in the L value and the Mann-Whitney test results for the Chrome value showed $p = 0.00$ ($p < 0.05$) this is showed that at the Chrome value there was a statistically significant difference between the acrylic resin plate in the aquades group and the resin plate in the rosella flower tea group after additional 7 days of the immersion

5. DISCUSSION

This research was conducted to determine the effect of immersion rosella flower tea on the change in color of the heat cured acrylic resin plates for 7 days and additional 7 day immersion. The study was conducted on 32 samples divided into 2 groups: the control group and the treatment group. The results of this study obtained that average value of value control group was no difference but after soaking were significant differences. The average value of chrome control group was no difference but after soaking were significant differences. Friedman test results showed that rosella flower tea for additional 7 days had more effect on the

discoloration of the heat cured acrylic resin plate than immersion for 7 days. This means that the greater the change in the color of the acrylic resin heat cured polymerization heat, the greater the color change of the acrylic resin.

The discoloration of the acrylic resin plate can be caused by two factors, intrinsic and extrinsic. Extrinsically, these changes can be caused by anthocyanin compounds, found in roselle petals, which contain delphinidin-3-siloglucoside, delphinidin-3-glucoside, and cyanidin-3-siloglucoside, which produce strong pigments, such as red, orange, purple, and blue, when dissolved in water, [9] [11]. Intrinsically, one of the properties of acrylic resins is to absorb water slowly over a certain period of time, with the diffusion absorption mechanism of water molecules according to the diffusion law. The absorption of liquid dyes in acrylic resin is one of the factors causing the discoloration of acrylic resin. [15] Rosella flower tea solution contains several acidic chemical compounds, namely a mixture of citric acid and malic acid, anthocyanin hydroxyflavone and hibiscin, vitamin C and amino acids. [2] According to Anusavice, acrylic resin absorbs relatively more water when placed in an acidic environment. This allows the accumulation of more anthocyanin dye absorption into the acrylic resin plate. The physical properties of hot polymerized acrylic resin are porosity. Porosity determines the sticking of the porous color particles. The more porosity, the more accumulation of dyes absorbed through the diffusion process will also increase. The length of contact between the resin material and the colored substance as contained in the roselle flower tea solution can affect the color change, this is because the longer the resin material is soaked, the more major color change that occurs. In addition, color stability and surface roughness are closely related to each other. The rougher the surface, the easier it is to accumulate stain, causing discoloration of the restoration material. [2]

The same result was also obtained by Zulkarnain et al. (2017) which uses 40% rosella flower extract as a natural disinfectant. This study proved that there was a significant color difference in the immersion of hot polymerized acrylic resin in rosella flower extract solution within 61 hours (1 year of use), 122 hours (2 years of use), and 183 hours (3 years of use) with $p = 0.025$. ($p < 0.05$). [13] However, the difference from this study was the shape and size of the acrylic resin used, the plate size used by Zulkarnain was cylindrical with a diameter of 50 ± 0.1 mm and a thickness of 0.5 ± 0.1 mm. Whereas in this study an acrylic resin plate was used with a size of 20 x 10 mm and a thickness of 1

mm. According to Anusavice, the color changes that occur in resins can vary, this is due to several factors, including sample size, sample microporosity and duration of contact between materials. The wider the sample size, the greater the physical changes in the material can occur. [2] This study is also in line with the results of the study of Tunggal et al. (2015) who used a roselle denture cleaning paste (2.5%) which was used by 5 denture wearers every day and the changes were calculated every 3rd, 6th, and 9th months. The results showed a change in the color of the acrylic base, statistically significant after using the paste for 6 and 9 months. [18] However, the difference from this study was that this study was conducted in vitro, whereas Tunggal et al. conducted an in vivo study where subjects used acrylic-based dentures and used rosella cleaning paste daily for 9 months. Exposure to roselle dye, anthocyanin, continuously for a long period of time allows this dye to enter the pores created by the microporosity nature of acrylic, causing the acrylic plates to turn redder after using the paste every day for 9 months. [18]

Different research results obtained by Thalib et al. (2013) who immersed hot polymerized acrylic resin in roselle petals extract with a concentration of 40% with 6 test groups, namely: immersion group 5 minutes, 10 minutes, and 15 minutes once a week, and 5 minutes, 10 minutes, and 15 minutes twice a week. Soaking is carried out for 4 weeks. It can be said that the longest immersion time is 15 minutes twice a week for 4 weeks, which is 120 minutes or equal to 2 hours of immersion ($15 \text{ minutes} \times 2 \times 4$), while the immersion in this study was carried out for 24 hours in 7 days and after additional 7 days.

The absence of this significant color change could be due to the not too long contact time so that the natural dyes in the roselle petal extract, namely anthocyanins, have not diffused into acrylic and cause significant color changes in acrylic resin. [19] Diffusion of liquid into acrylic resin is also one of the disadvantages of acrylic resin because the process of slow absorption of liquid over a long period of time not only affects the color stability of the acrylic, but also the mechanical properties and dimensions of the polymer. Rough or porous surfaces can also affect the color stability of the acrylic as this can lead to greater absorption of water and food coloring. Porosity can occur as a result of the evaporation of unreacted monomers and low molecular weight polymers, when the resin temperature reaches or exceeds the boiling point of the material, but this type of porosity does not occur uniformly along the affected resin segments. [2]

6. CONCLUSION

Based on the results of research that has been done, it was concluded that there were changes in the color of the heat cured acrylic resin plates after immersing in rosella flower tea solution for 7 days and additional 7 days. The color change after additional 7 day immersion was more significant than 7 day immersion. The longer the immersing time, the greater the potential for color change. Things that can be done to progress this research going forward are conducting research with a larger amount of samples and do a longer immersion time trial in order to get a more accurate final result.

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This certificate is awarded to

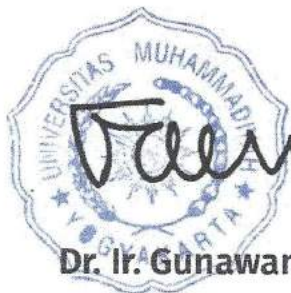
Fransiska Nuning Kusmawati

in acknowledgement of your participation as

PARTICIPANT

at The 5th Dental Research and Exhibition Meeting (DREAM)
held from 13th – 14th October 2020 at the Universitas Muhammadiyah
Yogyakarta, Indonesia

Rector of Universitas
Muhammadiyah Yogyakarta



Dr. Ir. Gunawan Budiyananto
Dr. Ir. Gunawan Budiyananto, M.P., IPM

Chairperson of
4th ICoSI 2020



Dr. Yeni Rosilawati, SIP., SE., M.M