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THE EFFECT OF 25% BAY LEAF EXTRACT AND 75% SMALL WHITE GINGER EXTRACT IMMERSION IN THE COLOR CHANGE OF ACRYLIC BASE

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ABSTRACT

Background: The most widely used denture is made from heat cured acrylic type. Acrylic resin has some disadvantages, one of which is easy to absorb liquid like water or chemical that affect color change. Alkaline peroxide is a denture cleanser that mostly sold on the market. A mixture of 25% bay leaf and 75% small white ginger extract can be used as natural denture cleanser. **Objective:** This study aimed to know the color change of heat cured resin base that immersed in a mixture of 25% bay leaf and 70% small white ginger extract. **Method:** This study was true experimental study with pretest and posttest with control group design, using simple random sampling. The sample was round with a diameter of 15mm and thickness 2mm. The samples were 18 heat cured acrylic resins which were divided into 3 groups, the mixture of 25% bay leaf and 70% small white ginger extract, alkaline peroxide, and aquades. The color change of the sample was tested using digital analysis tools set. **Results:** The mean value of color change of heat cured acrylic resin base after immersion in a group of mixed extracts, alkaline peroxide, and aquades were (5.22), (3.45) and (2.46). Data were analyzed using the One Way ANOVA parametric test and Bonferroni Post Hoc test. **Conclusion:** There is a difference in color change on the heat cured resin after immersion in a mixture of extract and alkaline peroxide. The value of acrylic resin that immersed in mixed extract has the higher color change.

Keywords: Bay leaf and small white ginger extract, color changes, heat cured type acrylic resin.

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INTRODUCTION

Loss of teeth can cause various effects, such as functional, mastication, and aesthetic impacts. It is necessary to use denture to fix the impact. According to the results of the RISKESDAS in 2018, in Indonesia, mostly loss of teeth was at the age of 65 years and over with a prevalence of 79.8%, while those using denture were only 5.8%.^{1,2,3}

Heat cured acrylic denture is the most widely used because it is easy to manufacture, the price is relatively low, lightweight, have the same color as the gingiva and can be repaired without having a new denture. Acrylic resin has shortcoming which is easily broken; there is a change in color of the base of acrylic resin after a long time of use, and easily to be porous and absorb liquid.^{4,5}

Denture can be cleaned mechanically, chemically, or combination of both. The method of

cleaning denture with a chemical method is immersion with a cleaning solution, one of which is by using alkaline peroxide, that is available in tablet and powder. This denture cleanser can be used for 5 minutes or according to the manufacturer instructions.^{6,7,8}

Denture cleanser which is sold on the market, on average, comes from imported materials and the price is relatively high. The Indonesian government is increasing the use of traditional ingredients as an alternative medicine because Indonesia is rich in medicinal plants. One of which can be used as an alternative ingredient is bay leaf (*Syzygium polyanthum*) and small white ginger (*Zingiber officinale var amarum*).⁹

Bay leaf (*Syzygium polyanthum*) is one of the native Indonesian spices and widely used as a natural flavoring ingredient in dishes because of its distinctive aroma. Bay leaf can be used as an alternative to denture cleanser. It is because bay

leaf contain flavonoid which can denature protein and nucleic acid from microorganism in resin acrylic base.^{10,11}

The small white ginger rhizome can be used as an alternative to denture cleanser made from natural ingredient, because it is more economical and easily obtained. The ginger rhizome has phenolic compounds, such as essential oil which can acts as anti-microorganism that found on the base of heat cured acrylic resin denture.¹²

Both of these ingredients contain phenol compound which can kill microorganisms. However, phenol can change the properties of acrylic resin, one of which is a color change. Phenol is a compound that has a molecular weight smaller than the acrylic resin polymer. It causes phenol to penetrate the plate and terminate the long chain of acrylic resin polymer, so that the bonds between molecules decrease and cause discoloration on the base of the acrylic resin. This study aims to determine the effect of discoloration of heat cured type acrylic denture base which is immersed in a mixture of 25% bay leaf extract and 70% small white ginger extract, so that it can be used as an alternative natural denture cleanser.^{13,14}

MATERIAL AND METHODE

The implementation of the research began with getting the research permits and ethical clearances issued by the Health Research Ethics Committee of the Faculty of Dentistry, Universitas Lambung Mangkurat No.153/KEPKG-FKGULM/EC/1/2019. This study was true experimental study with pre-test and post-test with group control design. The sample in this study used round curved type heat cured acrylic resin with a diameter of 15mm and 2mm thick using the ADA (American Dental Association) specification no.17. The sample numbered to 6 pieces in each group. The total sample was 18 pieces with the sampling technique using simple random sampling to determine the sample in 3 immersion groups. Group 1: a mixture of bay leaf extract 25% and small white ginger 70%. Group 2: alkaline peroxide as positive control. Group 3: aquades as negative control. The duration of immersion in this study was 1 day 6 hours and 25 minutes.

Sampling was carried out in the wet laboratory of the Faculty of Dentistry, Lambung Mangkurat University, Banjarmasin. The making of acrylic resin base samples was using round acrylic mold with a diameter of 15mm and 2mm thick using ADA specifications number 17. First, mold space was made by making a cast dough. The dough was made by mixing gypsum powder and water, then was put into cuvette and vibrator. After the gypsum became hard cold mold seal (CMS) was applied and the heat cured acrylic resin material was stirred in a stellon pot with a ratio of 3: 1 until it reached dough stage, then put it in the

space mold. the plastic cellophane was placed between the top cuvette and bottom cuvette, then the top cuvette was attached and closed. the cuvette was pressed using a hydraulic press with pressure of 1000psi (70kg/cm²). After, the cuvette was opened and the excess acrylic was cut. the cuvette was pressed with a pressure of 2200psi (154 kg/cm²). The filled cuvette was put into a pot of boiling water for 30 minutes. Samples were then done by finishing and polishing to remove sharp parts using fraser bur, stone bur and continued with abrasive paper Number 800, 1000, 1200 in running water. The sample was then glazed using a wool wheel which was given with pumice powder to produce a completely flat, smooth, unporous, and shiny surface.^{2,15}

Bay leaf extract and small white ginger were made using maceration methods at the Biochemistry Laboratory of the Faculty of Medicine, Lambung Mangkurat University, Banjarbaru. Bay leaf and small white ginger were collected and cleaned with running water, then cut into small pieces and dried. Simplicia was pulverized to a powder and then mixed with 70% ethanol with a ratio of simplicia and ethanol was 1:5. The simplicia was then put into the rotary evaporator and evaporated with a water bath until thick extract was obtained. Small white ginger extract and bay leaf in thick preparations were then dissolved to obtain the desired concentration. The main solution of the mixture of bay leaf extract and the small white ginger extract was a combination of 25% bay leaf extract and 70% small white ginger extract with a volume ratio of 1:1.²

Sample color measurement and data processing were carried out in the laboratory of the Faculty of Biochemistry, Faculty of Medicine, Lambung Mangkurat University, Banjarbaru. Measurement of sample color change before and after immersion in a mixture of 25% bay leaf extract and 70% small white ginger, alkaline peroxide, and distilled water was carried out using series of digital analysis tools. Acrylic samples were inserted into the box and the pictures were taken using a high-resolution digital camera (webcam). The acrylic sample was placed in the middle while adjusted to the webcam. To standardize the light condition when taking photos, the lamp was used as a light source.

The results of digital images were automatically stored in the disc with JPEG format, and the color values were seen using the Color Component Extraction software. Color change was detected using the Commission Internationale de L'Eclairage color system standard (CIELAB) with the formula:

$$\Delta E = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$$

$$\Delta L = L_0 - L_1$$

$$\Delta a = a_0 - a_1$$

$$\Delta b = b_0 - b_1$$

Information:

ΔE	: The value of color change.
L	: Coordinate brightness (lightness) scale from 0 (black) to 100 (white).
a	: Red-green chromatic coordinates.
b	: Yellow-blue chromatic coordinates.
L_1, a_1, b_1	: Before immersion.
L_0, a_0, b_0	: After immersion.

RESULT

The results of the study of color change on heat cured type acrylic resin after immersion in a mixture of 25% bay leaf extract and 70% small white ginger, alkaline peroxide and aquades are as follows:

Table 1. Mean values and standard deviations of heat cured acrylic resin base.

Groups	Mean \pm Standard Deviations
The Mixture of Extract	5,22 \pm 0,52
Alkaline Peroxide	3,45 \pm 0,41
Aquades	2,46 \pm 0,34

Based on table 1, it can be seen that the highest color change value based on heat cured acrylic resin was found in the immersion group of the mixture of 25% bay leaf and 70% small white ginger extract with an average value of 5.22. The group that had the smallest color change value, was the aquades immersion group with an average value of 2.46.

The value of the measurement results was carried out by the data normality test using the Shapiro-Wilk Test, because the number of samples is less than 50 pieces. The results of the normality test obtained values in the mixture of extract was $p=0.916$, alkaline peroxide was $p=0.016$ and aquades was $p=0.072$ which meant that all groups were normally distributed with a significance value of $p > 0.05$. The data was then tested for homogeneity by using Levene's Test, and the p -value was 0.292, which meant data was homogeneous with significance value of $p > 0.05$.

After the data in all groups were normally and homogeneously distributed, it was followed by parametric tests using One-Way ANOVA and the results was $p=0.000$ ($p < 0.005$), this showed a significant difference in the value of the color change of the heat cured acrylic resin base after immersion. To find the significant differences in each group the data, then continued with using Post Hoc Bonferroni Test. The results of the Post Hoc

Bonferroni test showed a significance value of $p < 0.005$. It showed that there were significant differences in each group.

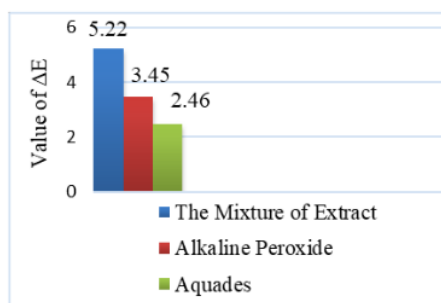


Figure 1. Mean Color Change Values Diagram of Base Heat Cured Acrylic Resin After Immersion.

DISCUSSION

Color measurement on the acrylic resin base was done using a digital analysis tool with CIELAB standards. If the value of ΔE was greater than 3.3, then the color change in the object can be seen visually. Color change in ΔL (lightness) plays the more important role in detecting color change than the Δa (red-green) and Δb (yellow-blue) values. It is because change in the value of ΔL can be seen visually.¹⁶

The results of the color change measurement of the heat cured acrylic resin base in the mixture of extracts, alkaline peroxide, and distilled water groups were significant after immersion for 1 day 6 hours 25 minutes. Bay leaf and small white ginger contained phenol that can change the color of heat cured acrylic resin base. Phenol can cause discoloration, because it tended to be acidic. The color absorption occurred when the heat cured denture base was immersed in the mixture of extract, which is visually brownish. The small white ginger extract contains dark brown oleoresin oil and bay leaf extract contain tannin that has yellowish brown color.^{15,17,18}

Alkaline peroxide is a commonly used denture cleanser and has anti-bacterial property to remove plaque and stains on the denture base. The presence of sodium perborate causes the color change in the used of alkaline peroxide. When sodium perborate is dissolved in water, it decomposes to form alkaline peroxide. Alkaline peroxide will produce H_2O_2 and O_2 (nascent oxygen). Nascent oxygen has mechanical and chemical effect in cleaning the acrylic resin base. Nascent oxygen has an intense oxidative action and released oxygen can cause oxidation of tertiary amine accelerator or unreacted double bonds in the resin matrix. These mechanism increase the value of L (brightness), a (green-red) and b (blue-yellow) based on acrylic resin after immersion.^{8,20,21}

Color change on the heat cured type acrylic denture base in the aquades immersion group due to

the absorption of denture bases against distilled water. Acrylic resin has a hydroxy group (-OH) in its methacrylate compound, and this group is negatively charged while aquades has an H₂O group so that (-OH) pairs with an H⁺ group. This process causes the acrylic resin to attract and absorb aquades through a diffusion process and increase the value of L and a. Aquades are visually bluish-white; this causes a decrease in b value.^{2,22}

Bay leaf extract and small white ginger contain tannin and oleoresin. Tannin and oleoresin are acidic phenol groups. When dissolved in water, they release H⁺ ions. The H⁺ ion in phenol will bind to the negative ion in the released ester resin group, CH₃O⁻. This ion exchange will cause the chemical bond of acrylic resin to become unstable, so that microporosity is formed and the extract mixture solution can fill the gaps. The H⁺ ion can cause chemical bonds in the acrylic resin to dissolve and decompose and are followed by the release of the monomer in the acrylic resin. It has an impact on the formation of cavities and the process of absorption in acrylic resin.^{5,19}

Color change of heat cured acrylic resin can affect the aesthetic of the denture base. Intrinsic factors can change the color of the denture base, because imperfect polymerization during the processes. Extrinsic factors occur due to the absorption of tea, coffee, and denture cleanser.^{23,24}

It can be concluded that there was a difference in color change on the heat cured resin after immersion in a mixture of extract and alkaline peroxide. The value of acrylic resin that immersed in mixed extract has more significant color change.

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