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THE SOAKING EFFECT OF 100% SMALL WHITE GINGER EXTRACT ON THE VALUE OF THE FLEXURAL STRENGTH OF ACRYLIC BASE

(Flexural Strength Value of Acrylic Base Using Acrylic Resin Heat Cured Type)

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ABSTRACT
Background: *The denture base material that is widely used is heat cured acrylic resin. One of mechanical properties of acrylic resin that must be considered in the selection of the basic denture material is flexural strength. Flexural strength is needed, among others, to resist the chewing power that must be received by dentures. The commonly used denture cleanser is Alkaline peroxide. 100% small white ginger extract can be used as natural denture cleanser.* ***Objective:*** *This study aimed to compare the flexural strength of heat cured acrylic base which in soaked 100% small white ginger extract with Alkaline peroxide solution as artificial denture cleanser.* ***Method:*** *This study was a pure laboratory experimental study with post test only with control group design, using simple random sampling. The sample was rectangular with a size of 65x10x2,5 mm. The number of samples used was 24 heat cured resin acrylic which was divided into 3 immersion groups, 100% small ginger extract, Alkaline peroxide, and aquades. The immersion carried out for 3 days 19 hours 25 minutes, obtained from 5 minutes denture cleanser presentation every day for 3 years. Flexural strength was tested using a Universal Testing Machine 3 Point Bending.* ***Result:*** *The everage flexural strength value of heat cured acrylic resin after soaked in 100% small white ginger extract was* 70,98*, in Alkaline peroxide 87,37, and 91,05 in aquades. The data was annalyzed using parametric One Way ANOVA test and Post Hoc Bonferroni test.* ***Conclusion:*** *The flexural strength of heat cured acrylic resin that soaked in 100% small white ginger extract is smaller than Alkaline peroxide after immersed for 3 days 19 hours 25 minutes.*

Keywords: *Flexural strength, heat cured acrylic resin, small white ginger extract 100%.*

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INTRODUCTION

The denture base material that oftenly used is heat cured acrylic resin. They are non-toxic, non-irritating, insoluble in oral fluid, good aesthetic, easy to process, easily repaired and small change in dimension.[1] Ideal place for plaque formation in dentures. The poor hygiene of denture can increase the accumulation of plaque on the surface of the denture base.[2] Cleaning of denture can be done by mechanical and chemical methods. Mechanical cleaning is done by brushing, while chemical cleaning can be done by soaking the denture with disinfectant.[3] The commonly used denture cleanser is Alkaline peroxide. Some researchers concluded that the use of daily denture cleanser can affect the flexural strength of acrylic resin. Flexural strength is the resistance of the acrylic resin base to a load, pressure and thrust when the mouth functions.[4] Flexural strength is highly considered as an indicator of the strength of a material. Poor flexural strength can cause denture base material not able to withstand excessive mastication load.[5]

Denture cleaners with chemical are widely on the market. Denture cleaners with traditional material need to be investigated because the advantage of traditional material is the more affordable price, especially for people who live in rural areas. According to the estimate by the World Health Organization (WHO), 80% of the world's population still depend on traditional medicine, including the use of drugs derived from plants. One medicinal plant that is widely used by the people in

Indonesia and has long been known is the rhizome of small white ginger (Zingiber officinale var. Amarum).[6] Small white ginger rhizome can be used as an alternative to natural ingredient of denture cleanser. Based on research by Saputera et al., 2017 which stated that small white ginger extract (EJPK) with a concentration of 100% has an optimal effect in inhibiting the growth of *Candida albican* . This is because small white ginger contains phenolic compound which act as antimicrobial.[7]

Based on the explanation above, this study was conducted to determine the effect to flexural strength of heat cured acrylic denture base which was immersed in a small white ginger extract solution with a concentration of 100%.

MATERIALS AND METHODS

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.081 / KEPKG-FKGULM / EC / XII / 2018. This study was a true experimental study true experimental with post-test with group control design. The sample in this study used rectangular curved type heat cured acrylic resin with a size of 65x10x2.5 mm using the ADA specification no.12. The sample numbered to 8 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: soaked in 100% small white ginger extract. Group 2: soaked in Alkaline peroxide as a positive control. Group 3: aquades as negative control. The duration of immersion in this study was 3 days 19 hours 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 size of 65x10x2.5 mm using the ADA specification no.12. First, making transparent acrylic resin base samples with rectangular shapes 65x10x2 mm, then added wax 0.5 mm so that the total resin size expected as 65x10x2.5 mm. The dough was made by mixing gypsum powder and water with a ratio of water: powder = 30 ml: 100 grams. then put into cuvette and vibrator. After that, type V gypsum with the same comparison was entered into gypsum type III quvet when the condition was half setting. After the type V gypsum starts setting, place the transparent acrylic that has been added to the wax in to the gypsum, then covered the gypsum with using vaselin. The top quvet was filled with type V gypsum, then leave it for half the setting. After adding type III gypsum over the vibrator, the cuvette was closed and pressed with the cuvette press.[4]

Soaking cuvette in hot water aimed to remove wax, after that the remaining wax was cleaned. 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/cm^2). After, the cuvette was opened and the excess acrylic was cut. the cuvette was pressed with a pressure of 2200psi (154 kg/cm^2). The filled cuvette was put into a pot of boiling water for 30 minutes. Samples were 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 to produced flat and smooth surface. Polishing was done with buffing wheel and cryt powder.[4] The sample washed and marked with a number at the bottom. The incubation stage was carried out in a 37℃ saline solution for 24 hours at the Microbiology Laboratory at Lambung Mangkurat University.

Small white ginger were made using maceration methods at the Biochemistry Laboratory of the Faculty of Medicine, Lambung Mangkurat University, Banjarbaru. 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 simplisia was then put into the rotary evaporator and evaporated with a water bath until thick extract was obtained. Small white ginger extract in thick preparations were then dissolved to obtain the desired concentration.[8]After that it would be soaked with 100% small white ginger extract, alkaline peroxide, and aquades.

Location of Testing Samples was at the Technical Materials Laboratory, Department of Mechanical and Industrial Engineering, Faculty of Engineering, Gadjah Mada University. Testing sample using Universal Testing Machine Machine 3 Point Bending. Specimens from rectangular acrylic resins were supported by two fulcrums on the lower surface while the upper surface would be given a continuous load in the middle of the specimen and stop when the test rod was broken. The load obtained was entered into the flexural strength formula.[9]

Flexural strength was calculated with formula:

$$\sigma = \frac{3PL}{2wt^2}$$

Notes:
σ = maximum bending stress (MPa)
P = load on fracture (N)
L = distance between two supporters (mm)
w = sample width (mm)
t = sample thickness or height (mm).

RESULTS

Based on the result, after immersion for 3 days 19 hours 25 minutes, flexural strength measurements of acrylic resin will performed using Universal Testing Machine 3 point bending tools. The results of measuring the average flexural strength values can be seen in Figure 1.

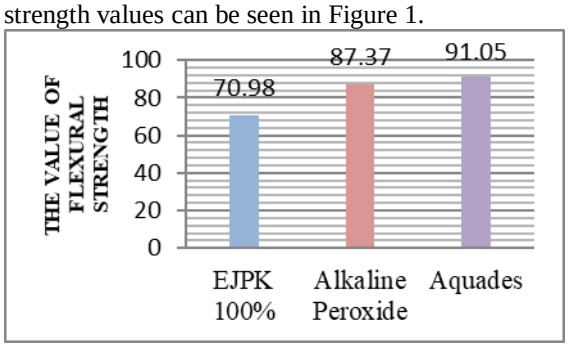

Figure 1. Average Value Diagram of the Flexural Strength of the acrylic resin base of *heat cured* type on soaking of 100% small white ginger extract, *Alkaline peroxide*, and Aquades.

Based on the picture above, it can be concluded that the flexural strength of acrylic base after immersion in 100% small white ginger extract (70.98) and *Alkaline peroxide* (87.37) has lower flexural strength than aquades (91.05). The flexural strength of acrylic base after immersion in 100% small white ginger extract was lower than immersion in *Alkaline peroxide* solution. After measuring using Universal Testing Machine 3 point bending tool and obtained the results then performed a statistical test.

Table 1. Average value and standard deviation of flexural strength of acrylic resin base of *heat cured* type on soaking of 100% small white ginger extract, *Alkaline peroxide*, and Aquades.

Soaking Group	Flexural strength value (MPa) Average ± SD
EJPK 100%	70,98 ± 6,22
Alkaline peroxide	87,37 ± 4,21
Aquades	91,05 ± 6,90

The results of the data were then tested for normality using the Shapiro-Wilk test and homogeneity using leven's test. The results obtained from the normality and homogeneity test showed that the data were normally distributed because all groups obtained results of $p > 0.05$. Data analysis was continued with the test of leven's homogeneity test to find out the variance or homogeneity of the group. The homogeneity test results show data of all groups homogeneous with a value of $p = 0.129$ ($p > 0.05$). It was followed by the parametric One Way Anova test. From the results of the One Way Anova test, p value = 0.001 ($p < 0.05$). From the data above, it can be concluded that there are significant differences. To find out the significant differences between groups, the Post Hoc Bonferroni test was carried out. The significance value tested using the Post Hoc Bonferroni test showed that there was a significant difference ($p = 0.000$) between the soaking using 100% small white ginger extract compared to soaking using *Alkaline peroxide* solution. There were significant differences ($p = 0.000$) between soaking using 100% small white ginger extract compared to soaking using distilled water.

DISCUSSION

Measurement of flexural strength values was done by three point bending test by placing the load at the center point of the sample until the object was broken. The maximum load value recorded in the test results was then calculated to obtain the flexural strength values.[10] From the calculation results, it was found that the value of flexural strength in this study was above the minimum flexural strength standard value based on ISO 20795-1 which was more than 65 MPa.[11]

The study of the effect of 100% small white ginger extract soaking on the value of acrylic base flexural strength showed that there were significant differences in the soaking group using 100% small white ginger extract compared to the soaking using *Alkaline peroxide* solution. There were significant differences between the soaking using 100% small white ginger extract compared to the soaking using distilled water. The significant difference in

flexural strength values of the treatment group and the control group was caused by the ability of water absorption from the material. Resin soaked in water will absorb water molecules and penetrate into the intermolecular space of the polymer chain so that the polar interaction decreases. This causes the distance between the polymers to increase, then the matrix expands. Then, the matrix softens so that the resin strength decreases. The higher the absorption of acrylic resin in absorbing the solution, the higher the flexural strength of the acrylic resin.[12]

The results of this study showed that there is a significant difference between the value of flexural strength of acrylic resin in the group of 100% small white ginger extract compared to the *Alkaline peroxide* group. This is caused by the content of *Alkaline peroxide* which affects the flexural strength of the acrylic plate. Hydrogen peroside releases oxygen (nascent oxygen) which damages the chain in a single bond. Hydrogen peroxide as an oxidizing agent has a free radical (nascent oxygen) which does not have an electron pair that will be released and then received by the resin matrix so that an oxidation reaction occurs. These free radicals will react with unsaturated bonds and cause interference with electron conjugation and changes in energy absorption in resin molecules that cause changes in the chemical structure of resin molecules.[13] Flexural strength depends on the length of immersion time and the type of disinfectant used. Flexural strength of acrylic resin will also decrease if the acrylic resin increases in absorbing water.[14]

There was a significant difference between the flexural strength of the acrylic base group of 100% small white ginger extract compared to the aquades group. This is in line with the results by Hamyulida Reni study (2015) that acrylic resin of *heat cured* type immersed in aquades is higher than other treatments, because aquades are pure water containing weak electrolytes. Aquades do not contain active ingredients which can dissolve particles that come into contact with acrylic resins so that they have little effect on the properties of acrylic resins.[15]

Small white ginger is known to have activity as an antifungal, antibacterial, antiviral and antioxidant. In this study, the small white ginger extract was used as a natural denture cleaner with a concentration of 100%. The concentration was based on the results of a study conducted by Saputera et al., 2017, saying that 100% small white ginger extract was considered more effective than 0.2% chlorhexidine gluconate to inhibit the growth of *Candida Albicans*.[8] The antifungal effect of the treatment of ethanol extract of small white ginger was due to the content of essential oils consisting of active compounds, which are *gingerol, shogaol, zingeron,* and *zingiberen. Gingerol, shogaol,* and *zingeron* are included in phenol compounds, which are known to denaturate *Candida albicans* cell membrane protein bonds, so that the cell membrane becomes lysis and phenol can penetrate into the cell nucleus, causing the fungus *Candida albicans* cannot develop.[6]

Flexural strength that occurs in acrylic resin of *heat cured* type in the immersion group of 100% small white ginger extract is because small white ginger contains phenol which when in direct contact with acrylic resin can cause chemical damage on the surface of acrylic resin. Phenol which is in direct contact with acrylic resin will react with esters of polymethyl methacrylate in acrylic resin. The polymer chain bond of acrylic resin is getting weaker because the compound will enter the acrylic resin surface and result in an expansion of the acrylic resin.[16] The bonding between molecules decreases thereby reducing the strength of the acrylic resin.[17] This is related to the mechanical properties of *heat cured* polymerization acrylic resin which conducted by Putri (2015) which showed that black tea drinks containing phenol can reduce the flexural strength of acrylic resin of *heat cured* type.[18] The results of the study can be concluded that there is an effect of soaking 100% small white ginger extract on the flexural strength of the acrylic base. The effect of 100% EJPK on flexural strength is lower than *Alkaline peroxide*.

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