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Effect Of Disinfection With Castor Leaf Extract (Ricinus Communis) On Candida Albicans, Surface Roughness And Color Stability Of Heat Polymerized Acrylic Resin Base

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Abstract
Background*: Heat Polymerized Acrylic Resin Denture Bases Have Biological Properties That Give Certain Microorganisms The Ability To Colonize Such As Candida Albicans. Denture Disinfection Can Be Done With Non-Traditional And Traditional Materials Such As Leaf Extract. Castor Leaf Extract (Ricinus Communis) Has Been Shown To Contain Tannin, Terpenoid, Saponin, Phenol And Flavonoid Phytochemical Compounds Which Are Effective As Antifungals.*
(10)
Materials and Methods*: Fresh Castor Leaves Were Made Into Extracts With A Concentration Of 50% And 60%. Disinfection Of Denture Base Samples In Chlorhexidine And 50%, 60% Castor Oil Extract To Observe Candida Albicans Inhibition Zones. After Disinfection, A Surface Roughness Test Was Carried Out With A Tool Profilometer And Color Stability Test With A Colorimeter*
Results*: The Results Of The Oneway Anova Test Were Significant With P = 0.0001 For The Candida Albicans Inhibition Zone And Color Stability, And P = 0.045 (P <0.05) For Surface Roughness. There Is An Effect Of Castor Leaf Extract As A Denture Disinfection Agent On Candida Albicans Inhibition Zone, Surface Roughness And Color Stability*
Key Word*: Disinfection, Roughness, Color, Castor Oil Leaves*

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I. Introduction

Dentures are a device that can replace the function of missing teeth and the surrounding tissue. Denture base materials used are divided into two, namely metal and non-metal. Based on their thermal properties, non-metallic materials are divided into two, thermoplastic and thermoset. An example of a thermoplastic material is thermoplastic nylon, an example of a thermosetting material is acrylic resin.(1) The denture base material that is often used today is hot polymerized acrylic resin, because it has good aesthetic advantages, texture and color similar to gingiva, small dimensional changes, relatively cheap price, more comfortable and lighter to use. This material also has the draw backs of absorbing liquids, poor thermal conductivity and having porous properties.(2) Hot polymerized acrylic resin has biological, mechanical, chemical and physical properties.Biological properties give the ability of certain microorganisms to colonize on the surface of the acrylic denture base and the most commonly found on the denture base is *Candida albicans*.The physical properties of hot polymerized acrylic resin are surface roughness, thermal conductivity, dimensional stability and color stability.(2) Instructions after insertion of dentures that must be considered by the patient are adequate denture disinfection. There are three common ways to disinfect dentures namely mechanically, chemically and combined. Chemical methods are said to be more effective in removing dental plaque and preventing denture stomatitis than mechanical methods and are also very suitable for the elderly and people with special needs. Chemical disinfection is carried out by immersing the dentures.(3)

Castor leaf extract (*Ricinus communis*) has shown antibacterial activity against various pathogenic bacteria.(4) The leaves are proven to contain flavonoids, saponins, and tannins. These compounds have antibacterial properties that are toxic to microorganisms such as *Candida albicans*..(5) In a study by Zulkarnain, et al (2016) soaking a hot polymerized acrylic resin base with rosella flower extract concentrations of 30%, 40%, 50% for 15 minutes was effective in inhibiting the number of *Candida albicans*, it was concluded that rosella

flower extract concentrations of 50% and chlorhexidine had the same ability to inhibit the number of *Candida albicans.*(6)

Disinfectants ideally can kill microorganisms and without destroying the properties of acrylic resin such as surface roughness and color stability.(7) According to Viona et al. (2016) The effect of cinnamon extract on the surface roughness of hot polymerized acrylic resin with a concentration of 40%, 50%, and 60% for 4 days to simulate 1 year of use, the surface roughness value of the base after soaking cinnamon extract with a concentration of 40% obtained a value of 0.169 µm , a concentration of 50% obtained a value of 0.229 µm and a concentration of 60% obtained a value of 0.322 µm. (8)

According to Nuuruha Y et al. (2019) Grape extract canmema effect the color stability of acrylic resin. The highest concentration of discoloration is 100%. Concentration that fulfilling the color change standards are concentrations of 12.5%, 25% and 50%.9 According to Prayitno et al. (2003) Flavonoids produce a red or orange color and tannins will cause a brown color.10 Anthocyanin is a substance that gives color to one class of flavonoid compounds. The higher the concentration of the extract, the higher the anthocyanin content that penetrates into theacrylic resin, causing the color of the acrylic resin to get darker. (9)

II. Material And Methods

The research design used was laboratory experimental. The research design used was a pretest-post-test with control group design which gave treatment to one or more groups and then the results were compared to the control group. This research was conducted in the USU FKG Prosthodontics Research Room and the Biology Laboratory of the USU Faculty of Pharmacy in January - May 2022.

a. Tools and Materials

Tools used metal master model size 10 × 10 × 2 mm for Candida albicans and surface roughness and diameter20±1mm and 2±0.1mm thickness for color stability, digital scales, rubber bowls, spatulas, cuvettes, lekrons, vibrators, acrylic pots, hydraulic presses, water baths, micromotors, straight handpieces, Fraser bur bits, jars, filter paper, stopwatch, tweezers, oven, profilometer, colorimeter, blender, syringe, pot container, rotary evaporator, rotary grinder and incubator. The materials used are hot polymerized acrylic resin, cold mold seal, hard gypsum, vaseline, cellophane, distilled water, coarse pumice, waterproof sand paper nos 400, 600 and 1000, 0.2% chlorhexidine, castor oil leaves, 70% ethanol , dimethyl sulfoxide (DMSO).

b. Sample making

Making the mold begins with making hard plaster dough, the ratio of gypsum to water is 100 grams: 30 ml of water for the top and bottom cuvettes. The dough is put into the cuvette that has been prepared above the vibrator. The main model is placed on the gypsum dough which is starting to harden in the cuvette, the gypsum is tidied up and left to stand until it hardens completely (figure 1a). The surface of the cast and cuvette is smeared with vaseline then the top cuvette is attached and filled with hard plaster dough over the vibrator. After the gypsum has hardened, the cuvette is opened, the main model is removed, the cuvette is poured with hot water to remove the remaining vaseline until it is clean, after it is dry, spread with cold mold seal, wait for 20 minutes (according to the manufacturer's instructions) (figure 1b).

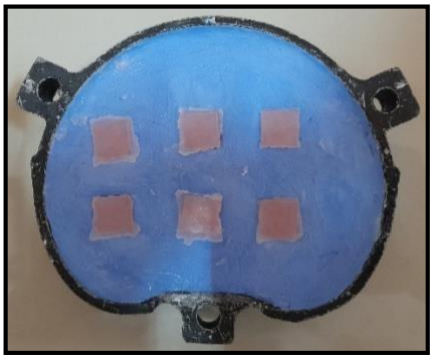
(a)

Figure 1a. Making mold

(b)

Figure 1b. Mold

Fill the acrylic resin in the mold. Polymer and monomer are stirred in a porcelain pot with a ratio of 2 gr : 1 ml according to the manufacturer's instructions and wait until the dough reaches the dough stage. The mold that has been smeared with the separator is completely filled with acrylic resin mixture. Plastic cellophane is placed between the top and bottom cuvettes, then closed and pressed gently with a hydraulic press with a pressure of 1000-2200 psi. The water bath is filled with water, the temperature and time are set at 70℃ for 90 minutes and 100℃ for 30 minutes. The cuvettes were removed from the water bath and allowed to cool to room temperature. (Figure 2a and 2b) Final solution, the sample is removed from the cuvette then trimmed to remove then smoothed with waterproof sand paper with the number 400, 600 and 1000 under running water using a rotary grinder until the desired size is obtained (figure 2c). Samples were soaked in distilled water for 48 hours before being given treatment to remove residual monomers**.**



(a)

(b)

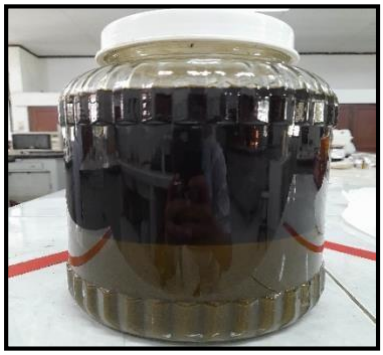
(c)

Figure 2a and 2b. Sample after curring

Figure 2c. Polishing

c. Extract manufacture

Extract preparation, castor leaves are washed with running water. Dry in an open room that is not exposed to direct sunlight to dry. Then grind it into simplicia using a blender. Simplicia of castor leaves was macerated using 70% ethanol with a ratio of 1:10 at room temperature for 5 days accompanied by stirring. The liquid extract was then filtered using filter paper (maserate I). Repeat the extraction process on the dregs using 70% ethanol to obtain macerate II (figure 3a) (figure 3b)



(a)

Figure 3a. Maserate

(b)

Figure 3b. Castor leaf extract

d. Preparation of test solutions

Preparation of test solutions with various concentrations using standard mother liquor (LIB). LIB 6 gr/10 ml (concentration 60%). Required 30 ml LIB, 6x3 = 18 gr. Weigh 18 g condensed castor oil extract and then dilute it with 30 ml DMSO to produce 30 ml of 60% castor leaf extract. Concentration lowered, 50÷60x10 = 8.3 ml, take the castor leaf extractas much as 8.3 ml, after that add 1.7 ml of DMSO. Produces castor castor leaf extract concentration of 50% as much as 10 ml.

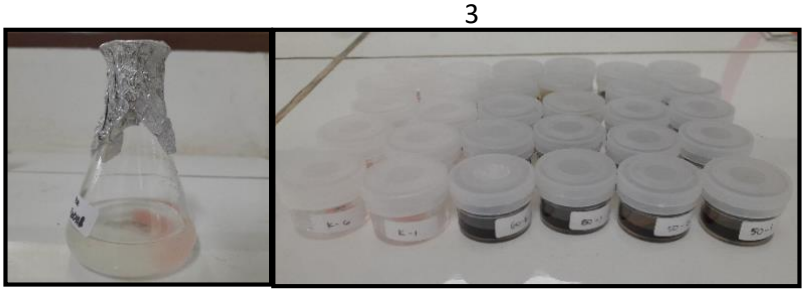
e. Inhibition Zone Testing for *Candida albicans* and Surface Roughness

Samples were sterilized using an autoclave at 121℃ for 1 hour then the samples were rinsed with distilled water, the samples were divided into 2 groups, namely group 1 disinfection with 0.2% Chlorhexidine, group 2 disinfection with 37℃ castor leaf extract (*Ricinus communis*), the sample was soaked in artificial saliva for 1 hour at 37°C. Then it was rinsed 2 times using Phosphate Buffered Saline (PBS), the sample was contaminated with *Candida albicans* (figure 4a) by placing it in an erlenmeyer tube containing *Candida albicans* suspension. Then incubated for 24 hours at 37ºC, after 24 hours the sample was removed from the test tube. Each one sample was put into a reaction vial containing 2 ml each category (figure 4b). Samples were soaked and stored in an incubator at 37°C for 4 days, then the samples were removed from the test tube and rinsed twice with PBS, the samples were put into a test tube containing 10 ml of 09% NaCl solution was then vibrated using a vortex vibrating device for 30 seconds to release *Candida albicans* attached to the sample, the paper disk was put into the test tube of the treatment group and the control group, *Candida albicans* isolate in the test tube was taken with a sterile stick the suspended in 9 mL of NaCl 0.9%, 1 ml of *Candida albicans* suspension was put into an erlenmeyer containing PDA (Potato Dextrose Agar) liquid, homogenized and then poured into a petri dish. Wait until it hardens, each paper disk is removed from the vial and then arranged on top of the hardened PDA media. Incubated for 48 hours at 37°C, the diameter of the inhibition zone was measured with a caliper in millimeters. *Candida albicans* isolate in a test tube was taken with a sterile stick then suspended in 9 mL of 0.9% NaCl, 1 ml of *Candida albicans* suspension was put into an erlenmeyer containing PDA liquid, homogenized then poured into a petri dish. Wait until it hardens (figure 4c), each paper disk is removed from the vial and then arranged on top of the hardened PDA media. Incubated for 48 hours at 37°C, the diameter of the inhibition zone was measured with a caliper in millimeters (figure 4d).

Measurement of surface roughness On each sample, 3 measurement points were made (1 mm from the edge of the sample) using a marker before the initial surface roughness was calculated. The sample is placed on a flat plane, after which the operator places the stylus (needle) at the first point on the surface of the sample. Then the tool is activated, the stylus will move along a straight line (horizontal) 8 mm long and back again. The monitor/screen of the test equipment will show the surface roughness value of the sample being measured (figure 4e), then proceed with measurements at 2 other points using the same procedure. After obtained, the three measurement results obtained are averaged to obtain the final roughness value with the formula

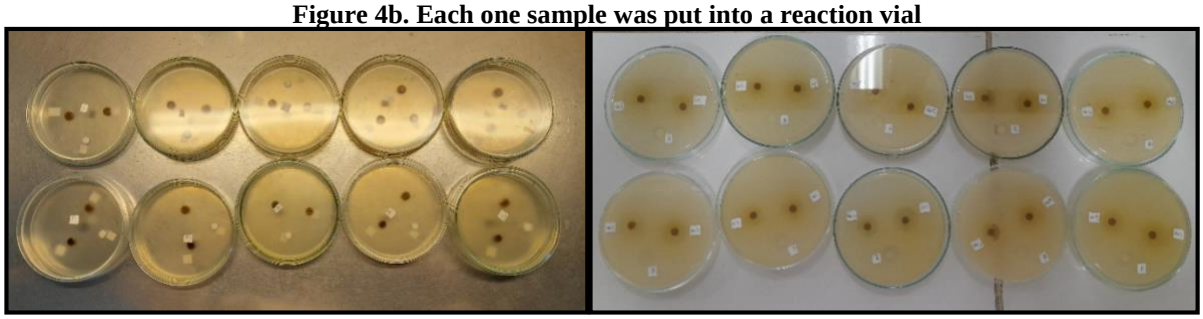
$$Ra = \underline{Ra1+Ra2+Ra3}$$

3



(a) **(b)**

Figure 4a. Sample was contaminated with *Candida albicans*
Figure 4b. Each one sample was put into a reaction vial



(c) (d)

Figure 4c. The hardened PDA media
Figure 4d. The diameter of the inhibition zone

(e)

Figure 4e. The surface roughness value

f. Color Stability Testing

Samples were soaked in distilled water for 48 hours before being given treatment to remove residual monomers. The samples were divided into 3 groups namely, group A was immersed with 0.2% chlorhexidine disinfection, group B was immersed with 50% disinfection of castor oil (*Ricinus communis* L) leaf extract and group C was immersed with 60% disinfection of castor oil (*Ricinus communis* L) leaf extract. %. Samples were soaked and stored in the incubator for 4 days assuming 1 year. Any disinfection used is replaced daily.After the sample is soaked, the sample is removed and rinsed using distilled water and then dried. The measurement of color stability in this study was by using a colorimeter. Press the "on" button to turn on the colorimeter. Calibrate first by pairing the black cavity followed by the white cavity.The sample is placed on a table with a white base and the colorimeter is placed vertically above the sample with the sensor in the center of the sample.Take measurements according to the instructions for using the colorimeter.The measurement result in the form of a value of L a* b* will appear on the monitor screen.After use, press the "off" button to turn off the colorimeter**.**Measure the color of each sample to get the color value,then calculated by the hunter formula.

$$\Delta E = [(\Delta L^*)2 + (\Delta a^*)2 + (\Delta b^*)2)]1/2 \text{ g.}$$

Statistics

Data analysis used in this study was univariate test analysis to find out the average standard deviation of each group, then ANOVA test to test the effect of disinfection with 0.2% chlorhexidine, 50% and 60% of castor

curcas (*Ricinus communis*) leaf extract on surface roughness and color stability of acrylic resin denture base polymerization.

III. Result

Diameter of Candida albicans inhibition zone formed on agar mediameasured using a caliper in millimeters. In the research results it was found that the diameter of the inhibition zoneCandida albicansin group A with chlorhexidine as a disinfecting agent the mean value and standard deviation were 13.09±1.02mm. The diameter of the Candida albicans inhibition zone in group B with castor leaf extract concentration of 50% as a disinfecting agent with a mean value and standard deviation of 14.47±1.249mm. Diameter of Candida albicans inhibition zone in group C with castor leaf extract concentration of 60% as a disinfecting agent with a mean value and standard deviation of 16.755±1.974mm. (Table 1)

Surface roughness value after 1 year disinfectionin group A the smallest roughness value is 0.124 µm and the largest value is 0.308 µm, with an average value and standard deviation of0.196± 0.051, in group B the smallest roughness value was 0.126 µm and the largest value was 0.188 µm with an average value and standard deviation of 0.154 ± 0.019 and in group C with the smallest roughness value was 0.113 µm and the largest value was 0.236 µm with an average value mean and standard deviation 0.187 ± 0.034. (Table 2) The color change value after 1 year disinfection in group A the biggest color change value is 2.22, the smallest value is 1.17, with the average value and standard deviation is 1.58 ± 0.31, in group B the biggest color change value was 3.28, the smallest value was 2.74, and the mean value and standard deviation were 2.97 ± 0.18, and in group C the largest color change value was 3.93, the smallest value was 3.10, and the the mean and standard deviation is 3.50 ± 0.26. (Table 3)

Table no 1: Diameter of inhibition zone of phytochemical compounds of castor leaf extract (*Ricinus communis*) as denture disinfection against *Candida albicans*

		Inhibition Zone Diameter	
NO	Group A	Group B	Group C
1	11.8*	13.85	14.65
2	13,8	15,2	16.5
3	11.95	15.65	19
4	12,1	14.45	16,6
5	12.55	13*	14*
6	12,8	15.65	19,2
7	13,7	14,3	16,4
8	14.8**	16.5**	19.7**
9	14,2	13,1	16.5
10	13,2	13*	15
$\bar{x}$ ±SD	13.09±1.02	14,47±1.249	16,755± 1.974

Information: * Least Value
** Greatest Value

The results of the one way Anova test obtained a significance of p = 0.0001 (p <0.05). This shows that there is a disinfection effect of chlorhexidine and castor leaf extract (*Ricinus communis*) concentrations of 50% and 60% on *Candida albicans* inhibition zones on hot polymerized acrylic resin denture bases.

Table 2. Surface roughness values of hot polymerized acrylic resin denture base after disinfection with 0.2% chlorhexidine, 50% and 60% castor oil extract.

		Surface Roughness Value	
NO	Group A	Group B	Group C
1	0.233	0.126*	0.175
2	0.308**	0.147	0.214
3	0.151	0.166	0.22
4	0.197	0.188**	0.2
5	0.147	0.148	0.189
6	0.183	0.132	0.197
7	0.124*	0.171	0.236**
8	0.208	0.166	0.113*

9	0.21	0.16	0.163
10	0.208	0.141	0.17

Information : * Smallest value ** Greatest value

The results of the ANOVA test obtained a value of p = 0.045 (p <0.05) for groups A, B and C. This showed that there was an effect of the disinfection effect of chlorhexidine and castor curcas (*Ricinus communis*) leaf extract concentrations of 50% and 60% on roughness. denture base surface of hot polymerized acrylic resin.

Table 3 : Value of color change of denture base heat polymerized acrylic resin after disinfection with 0.2% chlorhexidine, 50% and 60% castor oil extract.

		Color Change Value	
NO	Group A	Group B	Group C
1	1.45	3,10	3.61
2	1.49	2.74*	3.72
3	2.22**	2.81	3,28
4	1.19	3.09	3,36
5	1.46	3.08	3.93**
6	1.80	2.97	3,10*
7	1.78	3,10	3,33
8	1.17*	3.28**	3.80
9	1.78	2.85	3.58
10	1.52	2.74*	3.30
x̄ ±SD	1.58±0.31	2.97±0.18	3.50±0.26

Information : * Smallest value ** Greatest value

The results of the Anova test obtained a value of p = 0.0001 (p 0.05) for groups A, B, and C. This shows that there in group A, the diameter of the inhibition zone formed indicated the absence of *Candida albicans* growth around the paper disk due to the antimicrobial effect of chlorhexidine which can significantly reduce the growth of microorganisms, especially *Candida albicans*. Chlorhexidine has a mechanism of action, namely by binding to the fungal cell surface through ionic bonds, chlorhexidine also has a high degree of antimicrobial activity which when it binds to fungal cell membrane components causes changes in the integrity of the fungal cell wall. The change in the integrity of the cell wall causes the function of the cell membrane to disappear. In Rakhmatullah's research in 2018, Groups B and C also produced a larger inhibition zone than group A. This was an effect of disinfection with 0.2% chlorhexidine, 50 and 60% castorella leaf extract, on the color stability of denture base heat polymerized acrylic resin.

IV. Discussion

Due to the anti-fungal content contained in the castor leaf extract, namely flavonoids, saponins, tannins, and terpenoids. The mechanism of action of flavonoids against Candida albicans is to disrupt cell membranes by forming cell extract protein complexes and their cell walls undergo protein denaturation through hydrogen bonds in the fungal cell wall. The fungal cell wall has an important role in the survival of the fungus and its pathogenicity, which is a site of ion exchange and protein filtration, which is the metabolism and catabolism of complex nutrients. (11)

The mechanism of action of saponins is to reduce the tension of the sterol membrane which plays a role in the synthesis of Candida albicans cell walls so that their permeability increases. Increased permeability can result in the more concentrated intracellular fluid being pulled out which will then cause nutrients, metabolic substances, enzymes, and proteins in the cells to come out and the fungus to die. Tannin is one of the chemical compounds contained in castor leaf extract which also has effectiveness as an anti- fungal. Tannins, which are complex compounds of polyphenols, have a mechanism of action, namely reacting with cell walls and being able to inhibit cell synthesis of chitin, which is a component of Candida albicans. Terpenoids are also compounds that have effectiveness as strong antifungals against various pathogens, especially Candida albicans. Terpenoids can inhibit fungal growth, both through the cytoplasmic membrane and interfere with the growth and development of Candida albicans spores, one of the mechanisms of action is to create non- specific membrane lesions on the Candida albicans cell wall. (12,13) This is in accordance with research conducted by Pulungan in 2017, the results obtained were that turmeric leaf extract was effective in inhibiting the growth of Candida albicans at a concentration of 50% obtained an average inhibition zone diameter of 6.10 mm, a concentration of 60% obtained an average inhibition zone diameter of 7.47 mm.(14)

The surface roughness values varied for each sample because the polishing was done manually using a rotary grinder so that the pressure exerted during polishing could not be controlled. The existence of this pressure

difference will result in differences in the height of the peaks and valleys of the grooves formed on the polishing line. A little pressure applied can result in incomplete erosion of the base surface and a large pressure is applied resulting in more and more parts of the peaks and valleys of the groove being wasted so that the resulting average surface roughness will be smaller. (15)

The highest average surface roughness value was obtained in group A which has active component compounds, contains chlorine and has an acidic pH. The acidic nature of chlorhexidine will react chemically causing the solubility of the hot polymerized acrylic resin elements so that the surface of the hot polymerized acrylic resin base experiences erosion and causes roughness on the surface of the acrylic resin.(16) In group B, the average value of base surface roughness after disinfection was the lowest. In group C the average surface roughness value was higher than group B. In accordance with the research by Wardojo et al in 2019 it was stated that the higher the concentration of the extract, the greater the resulting surface roughness value . (17) Group B can be chosen as a good denture disinfection material because none of the surface roughness values exceed 0.2 and the average is smaller than group A, namely chlorhexidine which is the gold standard for denture disinfection.

From the results of the study, it was obtained that the color change values varied for each sample in one group. The difference in value is due to the different mechanism of action of disinfection between 0.2% chlorhexidine and 50% and 60% castor oil extract. Chlorhexidine 0.2% contains chlorine which has bleaching properties and causes a decrease in the value of acrylic resin. In acrylic resin disinfection with castorella leaf extract 50% and 60% contain flavonoids and tannins. According to Prayitno et al. (2003) Flavonoids produce a red or orange color and tannins will cause a brown or brown color.(10) There was penetration of the material into the microporosity of the resin surface, so the color change value obtained was the result of the coloring agent from the castor leaf extract. The higher the concentration of the extract, the higher the content that can penetrate into the acrylic resin, causing the color of the resin to become darker. This can be seen by the increase in the mean value of each sample group. The value of group C is higher than A and B where this is due to the acrylic resin absorbing the solution and its contents. (18)

One of the properties of acrylic resin is to absorb water, water absorption can affect the color stability of heat polymerized acrylic resin. Water molecules can interfere with acrylic resin polymer bonds, the disruption of these bonds causes stretching in the polymer chains. Strain on the polymer chain can cause losses that can affect the physical properties of the polymer. Generally the absorption of water that occurs is diffusion. Diffusion is the movement of one substance through a cavity, or through a second substance. In this case, water molecules penetrate the acrylic resin mass and occupy positions between the chainspolymer. Disturbed polymer chains are forced apart, when disinfection of acrylic resin makes it easy for the disinfection compound to bind or damage the structure of the acrylic resin polymer which is experiencing tension. (9,19) The discoloration of samples disinfected with chlorhexidine was caused by the influence of the chlorine content or the chlorine found in chlorhexidine reacts more with acrylic, causing a bleaching effect which causes the acrylic color to turn lighter.7 The ability to absorb liquid from the surrounding environment by hot polymerized acrylic resin causes absorption of chlorhexidine solution into hot polymerized acrylic resin.

Chlorhexidine has an acidic pH of around 5.3-5.7 which is erosive and abrasive. The content of hydrogen ions (H+) in chlorhexidine can lower the surface tension of the base so that it is easy for liquid to diffuse into the ester group polymer chain and result in unstable polymer bonds. This degradation has an impact on the release of monomers so that the mechanical properties of hot polymerized acrylic resin will decrease. Such damage can cause surface roughness and cracks in the hot polymerized acrylic resin base. According to Andari et al in 2014 that the acidity of the solution can increase the solubility of the material and cause the surface of the composite resin to experience erosion and release of filler particles resulting in an increase in the surface roughness of the hot polymerized acrylic resin base.(16)

Castor leaf extract contains phenolic compounds which are phenol derivatives belonging to a group of weak acids with high polarity. Group C with a higher concentration than group B had more acid (H+) content so that the acid reacted with the hot polymerized acrylic resin elements and the base surface roughness value was higher.(20) Hot polymerizing acrylic resin is a polymer with a long polyester form consisting of low polarity repeating methyl methacrylate. Polyester esters in acrylic resins are easily hydrolyzed by acids so that they can cause cracks which cause irregularities on the base surface and increase surface roughness. This is in accordance with research by Wulandari in 2013, H+ ions in acids can cause degradation of polymer bonds so that some of the monomers from acrylic resin break away causing a lot of empty space between the polymer matrix and facilitating bonding between elements. The bonds that occur are C=O double bonds from the hot polymerized acrylic resin polymer chains with phenol groups. This reaction will cause the H+ ion from the phenol to be released and bind to the CH_3O^- ion released from the ester group. The benzene group on phenol will bind to the RCO of the ester group. This ion exchange reaction will cause many cavities resulting in increased surface roughness of the hot polymerized acrylic resin base.

The results of this study showed that there was an.(21) effect of disinfection of castorella leaf extract on groups B and C, this was due to the acrylic resin absorbing the solution and its contents, namely flavonoids and

tannins. The results of this study are in accordance with the research of Wirayuni KA (2019) that soaking rosella flower extract with a concentration of 60% rosella flower extract for 1 year can change the color of the heat polymerized acrylic resin base. This study found that rosella flowers can produce color changes due to the presence of natural coloring agents or anthocyanin-type staining agents that cause color changes.red which has the potential as a food and beverage coloring agent. This property causes substances that are hydrophilic in rosella flower extract to be absorbed by hot polymerized acrylic resin. (22)

The results of this study are also in accordance with the research of Nuruha Y, et al. (2019) black grape extract can affect the color change in acrylic resin. Concentrations that meet the standard for color change are concentrations of 12.5%, 25% and 50%. The color change upon immersion in grape extract concentrations of 12.5%, 25%, and 50% is still acceptable because it still does not exceed the maximum standard value for color change, which is 3.5. (23)

Discoloration that occurs on the hot polymerized acrylic resin base can also be caused by the presence of dyes attached to the surface of the hot polymerized acrylic resin base so that in this study disinfection of castor oil leaves caused the hot polymerized acrylic resin base to brown more. The higher the concentration of the extract, the higher the content that can penetrate into the acrylic resin, causing the color of the resin to become darker. (9) Disinfection of hot polymerized acrylic resin base with 0.2% chlorhexidine does not occur accumulation of dye attachment on the acrylic surface but instead there is a reaction of chlorine or chlorine with the acrylic plate resulting in a white effect and the color on the acrylic plate will become lighter.

In this study, the disinfection time used was 1 year with a concentration of 50% and 60%. It can be seen that 60% have reached the clinically accepted color difference threshold value of 3.5. This could be a consideration for future research not only to use 1 year, but to use for 2 years and 3 years of use at a concentration of 50% only, because a concentration of 60% has reached a clinically acceptable color difference threshold value of 3, 5.)

V. Conclusion

There was an effect of disinfection with 0.2% chlorhexidine, 50% and 60% castor oil extract on Candida albicans inhibition zone, surface roughness and color stability of denture base heat polymerized acrylic resin. Based on the results of the study, the best concentration for disinfection with castorella leaf extract against Candida albicans, surface roughness and color stability of denture base heat polymerized acrylic resin was a concentration of 50%.

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