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Effect Of Disinfection With Castor Leaf Extract (Ricinus Communis) On Water Absorption, Color Stability And Surface Roughness Of Heat Cured Acrylic

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Abstract:
***Background**: Continuous and porly maintained use of dentures can cause halitosis, poor aesthethic, and imflamation of the oral mucosa. Therefore, maintaining denture hygiene is crucial to prevent contamination of dentures by debris and microorganism. The solution for maximizing denture cleanliness is by soakaing the dentures in a disinfectant solution.*
***Materials and Methods**: Laboratory experimental study with a posttest only control group design*
***Results**: The water absorption experimental value of heat-polymerized acrylic resin denture base after disinfection for 1 year with a 50% castor leaf extract was 0.3819*±0.0288, and for 2 years wasa 0.4059±0.0273. The color stability value of heat-polymerized acrylic resin denture base after disinfection for 1 year with a 50% castor leaf extract was 1.50±0,23, and for 2 year was 2.26±0.75. The surface roughness value of heat polymerized acrylic resin denture base after disinfection with a 50% castor leaf extract for 1 year was 0.121±0.041 µm, and for 2 years was 0.137± 0.075 µm.
***Conclusion:** There is an effect of disinfection with a 50% castor leaf extract* (Ricinus communis) on water absorption, color stability, and surface roughness of heat cures polumerized acrylic resin denture base fpr 1 year and 2 yea simulation
***Key Word**: dentures, disinfection, castor leaf extract*

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I. Introduction

A denture is defined as a device that can replace some or all of the natural teeth that have been lost as well as mucosal tissue and can restore the aesthetics and functional condition of the patient. [1] The components of a denture consist of tooth elements, base and wire clasps. Dental elements are a substitute for natural teeth that have been lost. The denture base is part of the denture that is in the soft tissues of the oral cavity without interfering with the movement of the cheeks and tongue and as a place for the attachment of tooth elements. Denture base materials are biocompatible, easy to manipulate, easy to clean, insoluble in oral fluids and have high strength, roughness and stiffness.[1,2] The percentage based on the length of time the patient has been using dentures is 56.3% for a usage period of 0-5 years and 18.8% for a usage period of 6-10 years. Continuous wearing of dentures and not keeping them clean can cause halitosis, poor aesthetics and inflammation of the oral mucosa. Therefore, maintaining the cleanliness of dentures is very important, so that dentures are not contaminated by debris and microorganisms. There are 3 methods of cleaning dentures, namely: mechanically, chemically or a combination.[3]

The chemical disinfection method is proven to be better for denture wearers because of its advantages, including minimal abrasion and easy to do every day. Disinfectants can use chemical or natural ingredients. The World Health Organization recommends using traditional ingredients to treat and prevent various diseases, because traditional ingredients have fewer side effects than non-traditional ingredients and are relatively cheaper.[3,4] The chemical disinfectant that is commonly used is 0.2% chlorhexidine and a natural ingredient that is becoming known in the field of dentistry is the extract of Jatropha leaves (Ricinus communis). A good disinfectant must be able to kill microorganisms, especially Candida albicans on dentures. Another important consideration that must be considered is that the disinfection solution does not cause physical changes to the tooth base. Artificial properties include water absorption, color stability and surface roughness. The use of chlorhexidine for a long time can cause discomfort, caused by mucosal irritation, ulceration, changes in the sense of taste and causes discoloration of the teeth and tongue. Therefore, in this study using natural ingredients, namely castor leaves extract as a denture base disinfectant heat Page polymerized acrylic resin. Castor (Ricinus communis) is a plant that has the most properties to be used as medicine for diseases. Castor leaf (Ricinus communis) belongs to the Euphorbiaceae family. This plant is spread in almost all areas that have a tropical climate, one of which is Indonesia. The chemical compounds contained in the leaves of castor leaf include flavonoids, saponins, tannins, linolenic acid, glycosides, alkaloids, quercetin, kaempferol and steroids. Castor (Ricinus communis L.) has shown antibacterial activity against various pathogenic bacteria. It has been shown to inhibit the growth of several bacteria such as Escherichia coli, Staphylococcus aureus, K. pneumoneae, and Streptococcus progens. The leaves are proven to contain flavonoids, saponins, linolenic acid and tannins. These compounds have antibacterial and antifungal properties. Flavonoid compounds in castor leaf have the ability to inhibit the growth of Candida albicans with various mechanisms.[4,5] The purpose of this study was to determine the effect of disinfection with castor leaf extract (Ricinus communis) 50% on water absorption, color stability and surface roughness of denture base heat polymerized acrylic resin for simulations of 1 year and 2 years.

II. Material And Methods

Study Design: laboratory Experimental, the research design used was a posttest only control group design
Study Location: Sampling was carried out at the Prosthodontics Research Laboratory Faculty of Dentistry USU.
Study Duration: January-March 2023.
Sample size: cylindrical metal with a diameter of 50 ± 0.1 mm and a thickness of 0.5 ± 0.1 mm for the water absorption test and with a diameter of 20 ± 0.1 mm and a thickness of 2 ± 0.1 mm for the color stability test, and a size of 10 x 6 .5 x 2.5 mm for surface roughness test.

Procedure methodology

The first is making a mold space using a master model in the shape of 10mm x 65mm x 2.5mm and cylindrical with a diameter of 30 mm and a thickness of 5 mm. The gypsum dough is made by mixing the gypsum with water in a rubber bowl, then stirring it using a spatula. The gypsum dough is put into the bottom cuvette that has been prepared and then vibrated so that the air bubbles come out of the cuvette. The main model is placed on the plaster dough until setting. The gypsum surface of the lower cuvette is smeared with Vaseline and the top cuvette is filled with gypsum dough and then vibrated again so that there are no air bubbles. After the cast is set, the main model is removed and a mold is formed. The plaster surface that has been cleaned is smeared with CMS (could mold seal). The heat cured acrylic resin mixture is stirred in a stelon pot with a monomer and polymer ratio of 3:1 according to the manufacturer's instructions, the acrylic resin is stirred until the dough stage phase and the mixture is put into the mold until it is full. Close the lower cuvette and the upper cuvette and place a plastic cellophane between the cuvettes. Press the cuvette using a hydraulic press with a pressure of 1000psi then the cuvette is opened and the excess acrylic is removed and then the cuvette closed again and carried out a second pressing with a pressure of 2200psi. The cuvette is placed on a manual press and a bolt is attached to the cuvette to keep the cuvette tight. The cuvette that has been filled with acrylic is then put into a water bath for curing for 90 minutes at 70ºC then the temperature is raised to 100ºC for 30 minutes. After the curing process is complete, the cuvette is allowed to cool at room temperature and the sample is removed from the cuvette. Next, the finishing and polishing stages are carried out using a rotary grinding machine using sandpaper under running water to produce a flat and smooth surface.

Preparation of 50% castor leaf extract was carried out by maceration technique. Castor leaves that have been washed with running water are then cut into small pieces and dried in a drying cabinet for 4 days. The dried leaves were ground to a powder using a blender and then the powder was mixed with 70% ethanol solvent with a ratio of 1:10 and soaked for 24 hours with occasional stirring. Then the soaking results were filtered using filter paper and the resulting maserate I was carried out. The same procedure was carried out to obtain macerate II. The filtration results were then evaporated using a rotary evaporator with a temperature of 40ºC. Castor leaves extract 50% is obtained by preparing a suspension solution starting with mixing 0.3% CMC Na 2.1 g in 100 ml of distilled water. CMC Na is sprinkled slowly onto the surface of the distilled water that has been put into the mortar. The mortar was closed and allowed to stand for 15 minutes after that, crushed until homogeneous and removed. Add 350gr of thick castor leaf extract into the mortar then add 0.3% CMC Na little by little until it is homogeneous. The remaining distilled water is added up to 248 ml and crushed until homogeneous. Prior to soaking the acrylic resin, it was soaked in distilled water and put in an incubator at 37ºC for 24 hours to remove residual monomer.

Statistical analysis

Data was analyzed using SPSS version 22 (SPSS Inc., Chicago, IL). The data normality test was carried out first by using the Shapiro-Wilk test to find out whether the data was normally distributed.

the results are all p values> 0.05 this states that all data is normally distributed, after that homogeneity test was carried out using the Levene test and the results are p values > 0,05 this shows that the data are homogeneous. Because the data is normally distributed and homogeneous, the test is continued using the one-way Anova test to ascertain the significance the significance value of each variable. The level $P < 0.05$ was considered as the cutoff value or significance.

III. Result

Based on the measurements that have been carried out, the following results are obtained:

Table no 1 : Water Absorption Value

Group		Water Absorption Value (%)		p
		n	$\bar{x} \pm$ SD	
A1	4 days (1 year simulation)	5	0,3345 ± 0,0145	0,004*
B1		5	0,3176 ± 0,0291	
C1		5	0,3819 ± 0,0288	
A2	8 days (2 year simulation)	5	0,3580 ± 0,0237	0,0049*
B2		5	0,3276 ± 0,0388	
C2		5	0,4059 ± 0,0273	

Table no 2 : Color Change Value

Group		Color Change Value		p
		n	$\bar{x} \pm$ SD	
A1	4 days (1 year simulation)	5	0,63 ± 0,19	0,001*
B1		5	1,32 ± 0,19	
C1		5	1,50 ± 0,23	
A2	8 days (2 year simulation)	5	0,73 ± 0,13	0,001*
B2		5	1,51 ± 0,08	
C2		5	2,26 ± 0,75	

Table no 3 : Surface Roughness Value

Group		Surface Roughness Value		p
		n	$\bar{x} \pm$ SD	
A1	4 days (1 year simulation)	5	0,069 ± 0,127	0,025*
B1		5	0,105 ± 0,016	
C1		5	0,121 ± 0,041	
A2	8 days (2 year simulation)	5	0,065 ± 0,127	0,015*
B2		5	0,140 ± 0,053	
C2		5	0,137 ± 0,036	

IV. Discussion

In the 1-year simulation, the highest mean water absorption value in the heat-cured acrylic resin denture base was observed in group C1 (50% castor oil plant leaf extract). In the 2-year simulation, the highest mean water absorption value was found in group C2 (50% castor oil plant leaf extract). The mean water absorption value in group C1 was higher than in groups A1 and B1, while the mean water absorption value in group C2 was higher than in groups A2 and B2. This difference is attributed to the presence of flavonoids and tannins in the castor oil plant leaf extract. Tanin is known to be acidic, causing a reduction in the surface tension of acrylic resin. As a result, physical and chemical reactions take place through the porosities present on the surface of the acrylic resin, leading to the formation of numerous cavities on its surface, which subsequently increases the surface roughness and water absorption.[5,6] The study shows the impact of disinfection using 50% castor oil plant leaf extract in groups C1 (for 1-year simulation) and C2 (for 2-year simulation), which is influenced by the flavonoid and tannin content present in the extract. These compounds, being phenolic compounds, function as antimicrobial agents. However, when in contact with acrylic resin, phenolic compounds can cause significant chemical damage that affects the physical properties of the resin, such as color stability. The acidic nature of phenols allows them to release H+ ions from their hydroxyl groups in water. These H+ ions then combine with C=O double bonds in the polymer chains of heat-cured acrylic resin. This ion exchange reaction leads to the degradation of polymer chains, weakening the bonds in the acrylic resin and causing an increase in water absorption and a subsequent impact on color stability.[7]

In the 1-year simulation, the highest mean color change value in heat-cured acrylic resin denture bases was found in group C1 (castor oil plant leaf extract). In the 2-year simulation, the highest mean color change value was observed in group C2 (castor oil plant leaf extract). The mean color change value in group C1 was higher than in groups A1 and B1, while the mean color change value in group C2 was higher than in groups A2 and B2. This can be attributed to the presence of flavonoids and tannins in the castor oil plant leaf extract. Flavonoids can produce red or orange colors, and the structure of tannins, with conjugated double bonds in the polyphenols, serves as a chromophore (color producer) and has hydroxyl groups (OH) as auxochromes (color binding), which can cause brown coloration. The presence of colorants in the castor oil plant leaf extract and the ability to absorb color substances on the surface of heat-cured acrylic resin plates are due to the OH groups in tannins, which can oxidize the polymer and monomer components of heat-cured acrylic resin, resulting in color absorption and darkening of the acrylic resin.[9,10]

In the 1-year simulation, the surface roughness value in group C1 (castor oil plant leaf extract) was higher than in group B1 (chlorhexidine) due to the high content of flavonoids in the castor oil plant extract, which is the largest phenolic compound. Phenols can penetrate the acrylic resin, leading to the breaking of long polymer chains.[11] Similarly, the high pH value in the kelakai extract (Stenochlena palutris) with a high concentration of H+ ions causes an increase in surface roughness in acrylic resin. The spaces between the polymer chains in the ester group (COOH) will be filled with H+ ions and will break the double bonds of the C=O groups in the polymer chains, leading to the hydrolysis of ester groups and the formation of cracks.[12] These cracks cause an increase in surface roughness in acrylic resin. This finding is consistent with a study by Sari (2016) stating that the phenol content in cinnamon extract increases the surface roughness of heat-cured acrylic resin bases after a 1-year simulation (4 days) with concentrations of 40%, 50%, and 60%.[13]

In the 2-year simulation, the surface roughness value in group B2 (chlorhexidine) was higher than in group C2 (castor oil plant leaf extract) due to the acidic nature of chlorine in chlorhexidine solution. Acidic solutions can penetrate the micro-porosities of heat-cured acrylic resin and affect its physical properties. The long-term use of chlorhexidine can also change the color and affect the physical and mechanical properties of heat-cured acrylic resin. Chlorhexidine is an abrasive disinfectant, causing a relatively greater increase in surface roughness on the surface of heat-cured acrylic resin through diffusion.[1,14,15]

V. Conclusion

There is an effect of disinfection using 50% castor oil plant (Ricinus communis) leaf extract on water absorption, color stability, and surface roughness of heat-cured acrylic resin denture bases for a simulation of 1 year and 2 years.

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