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The effect of immersing the heat-cured acrylic resin plates into kitchen vinegar and star fruit (averrhoa bilimbi linn) solution to surface roughness base

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Abstract

Objective: To discover the effect of kitchen vinegar and star fruit to surface roughness base.

Material and Methods: This study was an experimental laboratory experiment with a pretest-posttest control group design. This study used 18 samples of heat-cured acrylic resin plates with size (30mm x 10mm x 2mm). They were divided into three groups; 1 control group (Group A) and 2 treatment group (Group B and C). Each group consists of 6 samples. Control group A soaked into aquades solution while treatment group B soaked into kitchen vinegar, and treatment Group C soaked into Star fruit. Each sample soaked for 24 hours. This study used Surface roughness Tester (SRT). Data analysis was done with one-way ANOVA and post hoc test analysis with 0,05 significant.

Results: On one-way Anova showed p=0,676 (p>0,05), which means kitchen vinegar and star fruit has no significant effect on the surface roughness base of heat-cured acrylic resin.

Conclusion: Based on SPSS ANOVA data, kitchen vinegar, and star fruit solution have no significant effect on surface roughness (Ra), but if seen descriptively, the longer the heat-cured acrylic resin plates immersed in acidic solution, the higher the roughness of the denture surface (Ra).

Keywords: Heat-cured acrylic resin plates, Kitchen vinegar, Star fruit (Averrhoa Star fruit Linn), Surface roughness
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Introduction

Replacement of missing teeth is one of the most critical requirements for patients who come to the clinic to restore aesthetics and function. One type of denture that is widely used is the acrylic resin denture base. Polymethyl methacrylate is the primary polymer for heat-cured acrylic resins.[1] This heat-cured acrylic has the advantage of easy to process and polish, aesthetic, affordable, and has low toxicity. Nevertheless, some of its shortcomings are easily fractured if dropped, discoloration, and porous.[2,3] Porous and discoloration on the surface of the base can be influenced by food or drinks consumed. In Indonesia, consumed foods and drinks are usually acidic, derived from vinegar or star fruit (averrhoa bilimbi L.) ingredients.

Vinegar ingredients have been known to humans since ancient times and are produced by various acetic acid-producing bacteria. Acetic acid also has the properties of tooth decay (caries dental). Research with a simulation of artificial caries (artificial caries dental) states that acetic acid damages teeth twice as strong as lactic acid. Other research found a brighter change compared with composite resin immersed in diluted vinegar and lime, which had previously been immersed in a solution of carbonation.[4]

As for star fruit (averrhoa bilimbi L.), which provides many benefits that are generally often used by the community as a spice in cooking, it was found that after immersed 7 to 14 days in star fruit extract with a concentration of 90%, 80%, 70%, there was a significant change in enamel surface roughness based on the type of star fruit, pH, and duration of immersion.[5]

Based on the nature of acrylic resin that can experience surface changes due to the consumption of acidic foods and beverages, the purpose of this study was to determine the effect of vinegar (acetic acid) & starfruit (averrhoa bilimbi L.) solution to the surface roughness of heat-cured acrylic resin.

Material and Methods

This study was an experimental laboratory with a pretest-posttest control group design. Research samples the samples used in this study were 18 pieces of heat-cured acrylic plates size 30 mm × 10 mm × 2 mm. The samples were divided into three groups with time immersion for the heat-cured acrylic resin is 24 hours. Before being given treatment, all samples were immersed in a solution of distilled water for four hours.

The 3 sample groups are: Group A (control group), immersed for 24 hours in aqueous solution; Group B (treatment group), immersed for 24 hours in a solution of kitchen vinegar; Group C (treatment group), immersed for 24 hours in a star

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samples: All samples of heat-cured acrylic plate size 30 mm × 10 mm × 2 mm were immersed vertically into a dark-colored glass bottle that had contained a solution of 60 ml distilled water and immersed for 24 hours. This immersion was a preliminary one to get all samples in the same state and eliminating the remaining monomers; After the samples removed from the distilled water, the surface roughness was measured with Surface roughness tester; Then the samples were immersed again in the solution according to the treatment group. For the treatment group, the pH of the solution has been tested using a pH meter to determine the pH level and get n the same pH concentration; After 24 hours of immersion, the sample was removed, and final observation of the acrylic plate surface roughness was done using a surface roughness tester. The measurement results will appear on the surftest monitor in digital numbers. Data analysis was done with ANOVA and Post Hoc Test.

Ethical clearance was approved by the Health Ethical Research Committee of Hasanuddin University (0190/PL.09/KEPK FKG-RSGM UNHAS/2019)

Results

A pH test was carried out before immersion on a group of kitchen vinegar solution and star fruit juice extract using a pH meter and result in an equal pH of 1.82. Table 1 showed the results of sample measurement analysis for each group: ANOVA test results for all Ra samples showed p = 0.158, the 95% confidence level, which showed that there was no significant difference in surface roughness between all heat-cured acrylic resin samples after immersed in distilled aquades.

Table 1. The results of the initial measurement of all samples immersed in the solution of distilled aquades as a control for 24 hours in Anova Oneway

Groups	df	sig
Between Groups	2	.158
Within Groups	15	
Total	17	

Table 2. Measurement results of Ra groups immersed in solutions A, B, C, for 24 hours immersion in the Anova one-way test

Groups	df	sig
Between Groups	2	.178
Within Groups	15	
Total	17	

Table 3. Measurement results of Ra comparison between all groups of samples immersed in solutions A, B, and C for 24 hours in the Post Hoc Test

Groups	Mean difference	sig
A and B	-.616000	.222
A and C	-1.090333	.155
B and C	-.474333	.676

Table 2 showed the measurement result in the immersion group of heat-cured acrylic resin plates in a solution of A, B, and C, for 24 hours. ANOVA test results obtained by the results of P = 0.178 showed no significant effect of immersing in the kitchen vinegar solution and starfruit juice to the surface roughness of the acrylic resin heat-cured plate.

Table 3 showed measurement results of samples immersion in treatment groups A, B, and C for 2 4 hours, p = 0.522, p = 0.522 and p = 0.155, respectively with (α = 0.05) and 95% confidence level, which means there was no significant difference in surface roughness.

The results showed that the surface roughness of the heat-cured acrylic resin on the Ra measurements of all samples at the immersion of 24 hours for the treatment group C was higher than in the treatment groups A and B the 24 hours immersion.

Discussion

This study aimed to determine the effect of vinegar and starfruit acid solution on the surface roughness of the acrylic resin base (PMMA). The choice of acrylic resin is based on the resin's strengths because it meets the aesthetic requirements, stable color, non-irritating, non-toxic, low price, easy to operate, easy to manufacture, and repair. According to research by MK Aljabri, approximately 61.25% acrylic resin base used in the manufacture of acrylic resin denture material, although less superior nature properties than metal frame base.[6]

The irregular surface of acrylic resin is a characteristic of roughness. A study by Abuzar et al. reported that heat-cured acrylic resin's surface roughness should not exceed 0.2 μm. Clinically, this value is the ideal surface roughness for dental materials for the oral cavity.[7] Surface roughness (Ra) value were probably caused by several factors that affect the manufacturing process samples that can not be controlled during the study, among others, the content of residual monomers which acts as a plasticizer and techniques of stirring manually resulting in porous which can affect surface roughness of heat-cured acrylic resin. According to Alves, residual monomers that did not react during the curing process resulted in the remaining monomers acting as plasticizers and weakening the

physical properties of heat-cured acrylic resins.[8]

In the calculation of the surface roughness (Ra), we obtained values of surface roughness (Ra) P=0178 (p>0.05), and no significant effect on heat-cured acrylic resin plates immersion in diluted vinegar and starfruit. Although there was no significant effect when viewed descriptively, the longer the heat-cured acrylic resin plates are immersed in an acid-containing solution, the higher the surface roughness (Ra) base value. This is due to the acidic pH content in the kitchen vinegar, and starfruit solution, around 1.82, can cause increased surface roughness of heat-cured acrylic resins and decrease mechanical strength. The results of the study by Safya found that immersing the denture base of heat-cured acrylic resin in soft drinks containing acid increases the surface roughness of the acrylic resin. Because the H+ion will fill the gap between the polymer chains in the polyester bond (COOH) so that the H+ion will separate the double bond C (C=O) from polymethyl methacrylate and ultimately degrade the chemical bond of the hot acrylic polymerization resin, and lead to the polymer bonding instability and chemical bonds to break. Esters are easily hydrolyzed by acids and form cracks on the surface of heat polymerized acrylic resins. These cracks cause surface irregularities and increase surface roughness.[9] Research by Dewi Puspitasari et al. found that immersing with alkaline peroxidase caused more surface roughness than immersing in celery leaf solution.[10]

The result of this study showed there was no significant effect on the immersion with star fruit juice. Heat polymerization acrylic resin has a water absorption value of 0.69 mg / cm2 and has a polar COOH group. Polar compounds have hydrophilic properties. This hydrophilic nature causes heat-cured acrylic resins to be durable in binding or absorbing liquids. The fluid absorption diffusion occurs, where the water molecule will penetrate the chain of polymethyl methacrylate and ranks among the polymer chains so that the polymer chain becomes separated and will lead to the formation of porosity, cause acrylic resin surface to become rough. Liquid absorption occurred slowly over time is thought to increase the surface roughness of acrylic resins.

Conclusion

This study concluded that there was no significant effect of heat-cured acrylic resin plates immersion in kitchen vinegar and starfruit solution against surface roughness (Ra) in each group. Surface roughness occurred in this study due to exposure to a solution of kitchen vinegar, and starfruit juice exceeded the recommended surface roughness limit of a denture base that is 0.2 μm, so it is not suitable to be used as a base of the denture.

Acknowledgment

None.

Conflict of Interest

The authors report no conflict of interest.

References

1. Kotha SMB, Lakshminarayana S, Shareef A, et al. Physical properties of heat cure denture base resin after incorporation of methacrylic acid. Contemp Clin Dent 2018;9: S251.
2. Nandal S, Ghalaut P, Shekhawat H, et al. New era in denture base resins: A review. Dent J Adv Stud 2013;1: 136-143.
3. Sharma A, Shashidhara HS. A review: Flexible removable partial dentures. J Dent Med Sci 2014;13: 58-62.
4. Hoppenbrouwers PMM, Driessens FCM. The effect of lactic and acetic acid on the formation of artificial caries lesions. J Dent Res 1988;67: 1466-1467.
5. Musnadi SIM, Noerdin A, Irawan B, et al. Effect of small starfruit (averrhoa bilimbi l.) extract gel on tooth enamel color changes. J Physics: Conference Series 2018;1073: 32006.
6. Aljabri MK, Ibrahim TO, Sharka RM. Removable partial dentures: Patient satisfaction and complaints in Makkah City, KSA. J Taibah Univ Med Sci 2017;12: 561-564.
7. Abuzar MA, Bellur S, Duong N, et al. Evaluating surface roughness of a polyamide denture base material in comparison with poly (methyl methacrylate). J Oral Sci 2010;52: 577-581.
8. Alves PVM, Lima FRMA, Telles E, et al. Surface roughness of acrylic resins after different curing and polishing techniques. Angle Orthod 2007;77: 528-531.
9. Sofya PA, Rahmayani L, Purnama RRC. Effect of soft drink towards heat cured acrylic resin denture base surface roughness. Padjadjaran J Dent 2017;29.
10. Puspitasari D, Wibowo D, Rosemarwa E. Roughness comparison of the heat cured type of acrylic resin in disinfectant solution immersion (immersion in a solution of alkaline peroxide and 75% celery extract (apium graveolens L)). J Dentomaxillofac Sci 2016;1: 99-102.