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COMPRESSIVE STRENGTH OF ACRYLIC RESIN PLATE AFTER *IMMERSING IN DENTURE CLEANSHER* ALGA CHOCOLATE

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ABSTRACT

Background: Immersion of acrylic resin plates in effervescent granules of 10% *sargassum policystum* as denture cleansher can inhibit the growth of *Streptococcus Mutans* and Candida Albicans. It is not yet known whether the resin can cause changes in compressive strength after immersion.
Aims: To determine the changes in compressive strength of acrylic resin plates after immersion in denture cleansher of 10% Sargassum *Policystum*.
Method: This laboratory experimental study used acrylic samples with a size of 25 mm × 15 mm × 2 mm totaling 18 pieces. The sample were divided into 3 groups, Sodium *Perborat* groups, *Sargassum policystum* 10% effervescent granules groups and aquadest groups. Immersion is carried out at room temperature with a immersion time of 4.8, and 12 hours. Compressive strength is measured using Universal Testing Mechine after immersion. The statistical tests used are the ANOVA Test and the LSD Test.
***Results*:** There was a decrease in the strength of the acrylic resin plate after being immersed in denture cleansher cleansher of 10% Sargassum *Policystum*, but it was not statistically significant.
Conclusion: Immersion of acrylic resin plate in denture cleansher of 10% Sargassum *Policystum* does not reduce compressive strength of acrylic resin plates.

Keywords: *Sargassum Policystum* Effervescent, Acrylic Resin, Compressive Strength

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BACKGROUND

To complete optimum degree of health and oral health, especially to avoid disturbances that can occur due to tooth loss, it is necessary to replace lost teeth with artificial teeth.[1] The most common type of denture used by patients today is acrylic resin based removable denture. Weaknesses of acrylic resin materials include porous and absorbing oral fluid which can affect the compressive strength.[2]

Cleansing denture acrylic resin by chemical means is more effective than mechanical means. So, we need cleaning agents that have bactericidal and fungicidal power, are easy to use, and are compatible with all denture ingredients.[3] Research has been carried out on the use of brown algae as a denture cleaning agent. Based on Zuhra's research, the minimum concentration of brown algae extract (Sargassum *sp*) Which can inhibit the growth of *Streptococcus mutans* and *Candida albicans* is a concentration of 10%.[4] Algae are one of the abundant marine biotas in Indonesian rivers, including Sulawesi South. Several types of algae have been reported to show antimicrobial activity, especially the brown algae group Sargassum and Turbinaria. The results of Kim and Lee's study in 2008 showed that *Sargassum* has the potential to have antibacterial activity. Based on Ardiansyah's research in 2005, *Saragssum polycystum* extract has a very strong antifungal activity because it can inhibit the growth of Candida albicans. As recommended by estab e 's instructions to cultivate the environment then one Sargassum that can be used as a denture cleanser is *Sargassum polycystum*[5]. In this paper, we will explain the effect of soaking of acrylic resin with an artificial denture cleaning agent from everfecent brown algae granules on transversal compressive changes.

Literature Review

Denture base is the place where the denture is attached. The durability and properties of a denture base are strongly influenced by the denture base material. Various materials have been used to make dentures, such as metals and resins, but there is no material that can meet all denture base requirements.[6] Compared to alloys such as Co / Cr and stainless steel, acrylic resins can be made of soft, weak and flexible materials. Denture base is made with adequate thickness, rigid, and strong. Acrylic resin also has a relatively low impact on strength and if this base is dropped on a rough surface, fractures are likely.[8]

1. Compressive Strength

Compressive strength of a material is defined as the ability of a material to withstand a load or mechanical force until failure occurs. This resin has unique strength properties. Compressive strength is 75 MPa (ASTM D 638). In general, this resin material has low strength. Effects that affect strength include composition, processing techniques, water absorption.[10]

Pressure strength is the maximum which the material can still receive the load without fracture. Compressive strength is an important property of a material because most of the strength of mastication in the form of compressive strength is the maximum strength that can be received by a material in the form of pressure without breaking.[9] Denture materials must have mechanical properties that are able to

withstand *strains* and *stress*. *Strain* is a change in the dimensions of a material. *Strain* phenomenon can be either elastic or plastic. A material is called elastic if after loading the material can return to its original dimensions. Meanwhile, if there is a permanent change of shape, then the material is called plastic. *Stress is* related to *strain*, where *stress* is an internal force per surface area. In uneven, curved, bumpy, folded, lined surfaces or deformed materials according to a design *stress* will arise. Things like this in making prostheses clearly must be prevented because of *stress*. Things like this in making prostheses clearly must be prevented because of the stress can be the cause of the failure of the use.[10]

One of the factors that can affect the strength of denture base material is acidic foods or drinks consumed by denture users. Drinks containing acid are beverages with a pH below 7, as well as coffee after fermentation has an optimum pH of 4.5-4.8. Coffee is a drink that is very famous in the world and is widely favored by various groups, both young and old. In addition, denture fractures can also be caused by impact pressures where accidentally falling dentures hit hard objects and flexural pressure, ie the repetitive flexural load on a material cannot withstand the flexural load anymore.[10]

2. Denture Cleaning Materials

Acrylic resin denture hygiene and oral hygiene can be protected from *Candida albicans* mold contamination by soaking dentures in denture cleaning agents at night. Denture cleaning agents on the market generally come from chemicals including alkaline peroxide, sodium hypochlorite, and chlorhexxidine gluconate.[11] Almost all denture cleaners circulating in the community contain chemicals. However, in accordance with government recommendations to carry out traditional safe tan cultivation, it is necessary to encourage the use of denture cleaning agents from natural ingredients. From the results of Vebri Geovani's research, the effect of 80% bay leaf (eugenia polyantha wight) as denture cleaner on compressive strength of heat-cured type acrylic resin with variations in immersion duration.

Effervescent Granules

Granule comes from the word granule which means grain. generally, before tablet printing, medicinal ingredients (active substances) and assistants are granulated, meaning that the powder particles are converted into granules. The granule has a sticky power, and the flow power becomes better. The requirements for good granules are in the form and color that are as regular as possible, have a narrow size distribution and contain powder-shaped parts of more than 10%, have good sliding capacity showing satisfactory mechanical compactness, not exceeding dryness (remaining moisture 3-5 %), destroyed both in water. Granules flow better than powder because they have a more rounded shape. From the same origin material, the granule form is usually more physically and chemically stable than powder and is usually more resistant to the influence of air. Granules are made not only containing medicinal elements but also dyes, flavor enhancers and flavor enhancers and other desired enhancers.[11]

Effervescent granules are granules that contain a mixture of granules that contain a mixture of acidic and carbonic substances which when put into water will emit gas.[12] The gas produced when carbon dioxide is dissolving effervescent so as to provide ef ek *sparking* (like soda).[13] The above reaction is undesirable to occur before *effervescent is* dissolved, therefore the water content and environmental humidity need to be controlled to prevent product instability. The solubility of raw materials is one of the important things in making *effervescent* granules. If the solubility is not good, then the reaction will not occur, and the granule does not dissolve quickly.[13] Making it possible to clean mechanically and chemically. Chemically, bioactives from cleaning agents will weaken bacteria and fungi on the denture plate. Mechanically through the release of CO2 produces froth which plays a role in releasing bacteria from the plate[13].

Chocolate Algae (Sargassum *sp*)

Alga Sargassum sp. or brown algae is one of the genus Sargassum sp. which belongs to the class of Phaepophyceae. Sargassum sp. contains alginate and iodine ingredients that are beneficial to the food, pharmaceutical, cosmetic and textile industries[15]. *Sargassum sp.* contains the main chemical content as a source of alginate and contains protein, vitamin C, minerals such as Ca, K, Mg, Na, Fe, Cu, Zn, S, P, and Mn, tannins, iodine, auxin and phenols. The content of substances in *Sargassum* sp. Extract. Like iodine, tannins, and phenols are quite good in inhibiting bacterial growth. The mechanism of action of tannin and phenol compounds in inhibiting bacterial cells, namely by denaturing bacterial cell proteins, inhibits nucleic acid synthesis so that bacterial growth can be inhibited.[15] Chocolate algae contain bioactive compounds such as Fucoxantin, steroids, phlorotannin, flavonoids and saponins. Bioactive compounds contained in algae is a potential that is very useful for the development of the pharmaceutical field, for example as a drug compound such as antibacterial.[16]

Material and Methods

The type of research used is *laboratory experimental* research. Based on the results of calculations, the number of samples used in this study was 27 samples. In this study, the sample was divided into 3 groups, namely group A (mineral water), group B (Sodium *Perborate)*, and group C (granule *effervescent sargassum policystum* 10%). The soaking time is 4, 8, and 12 hours for each sample group. Compressive strength testing of acrylic resin plates using *Universal Testing Mechine*. Data tabulated to tabular. The results of the study were then analyzed using a one-way ANOVA statistical test used to see the difference of some variance ($\alpha = 0.05$). Furthermore, if it is meaningful, a further difference test (post *hoc test)* is carried out, namely *least significant difference* (LSD).

Result

Acrylic material samples used materials, types of hot acrylic polymerization resins, manufacturing procedures, and plate sizes both the same length, width and thickness and are made by one person. Meanwhile, the determination of the number

of samples follows the rules of the Federer formula, so as to obtain 27 samples in total.

The results of research conducted at the Mechanical Laboratory of the Ujung Pandang State Polytechnic Engineering Department obtained an average value of immersion with water that is 40,222 on immersion for 4 hours, 29,779 on immersion 8 hours and 28,444 at 12 hours immersion.

The results of research conducted at the Mechanical Laboratory of the Ujung Pandang State Polytechnic Mechanical Department obtained an average value of immersion with *Sodium Perborat*, 38,000 for 4 hours immersion, 35,778 for 8 hours immersion and 31,556 for 12 hours immersion.

Results of research conducted at the Laboratory of the Department of Mechanical Engineering Polytechnic of Ujung Pandang, the average value obtained from soaking with *Sargassum Policystum* ie 38.889 on immersion for 4 hours, 36.667 on the 8-hour immersion and 32.556 on immersion 12 h am.

Table 5.4 is used to determine the effect of the treatment in the form of a type of cleaning agent, soaking time and a combination of the two.

Effect of type of cleaning agent

Based on table 2 we can find out the p-value for the type of cleaning material is 0.496. The conclusion drawing criteria is to compare the p-value with a significance level of 5% (0.05). The p-value is greater than the significance level of 5% (0.496> 0.05). In such a way that it is accepted it can be concluded that the type of cleaning material does not significantly influence the compressive strength of acrylic resin plates.

Effect of Soaking Time

Based on table 2 we can find out the p-value for the type of immersion time of 0.027. The conclusion drawing criteria is to compare the p-value with a significance level of 5% (0.05). The p-value is smaller than the 5% significance level (0.027 <0.05). In such a way that it is accepted it can be concluded that the immersion time significantly influences the compressive strength of acrylic resin plates.

Joint Effect Type of cleaning agent and duration of immersion

Based on table 2 we can find out the p-value for the type of material and immersion time of 0.697. The conclusion drawing criteria is to compare the p-value with a significance level of 5% (0.05). The p-value is greater than the significance level of 5% (0.697> 0.05). In such a way that it is accepted it can be concluded that the type of cleaning and soaking time does not significantly influence the compressive strength of acrylic resin plates.

LSD (Least *Significant Different)* Advanced Test

LSD (Least *Significant Different)* test is used to determine the difference in the effect of the two levels on the treatment given. LSD test on the treatment of material types wanted to know the differences in the effect of water immersion and immersion of *Sodium Perborate*, differences in the effects of water immersion and sargassum immersion, as well as differences in the effects of polysident immersion and sargassum immersion. While the LSD test for long immersion wants to know the difference in time of 4 hours by 8 hours, time of 4 hours by 12 hours, and time of 8 hours by 12 hours. Table 3 gives the LSD (Least *Significant Different)* test results for the types of cleaning agents, which are as follows:

Table 5.5 contains the p value used to determine the difference in effect of each type of material used. To determine the difference of each level in the treatment given by comparing the p-value in table 3 with a significance level of 5% (0.05), in this case if the p-value is less than 5% then there is a significant difference. From Table 3, we can conclude that the soaking water with *sodium perborate*, water immersion with sargasung, and soaking *Sodium perborates* and sargas sum has a p-value greater than 5% so that we can conclude that the overall level of the types of cleaning agents not terd apat significant difference.

Table 5.6 contains the p value used to determine the difference in effect from each immersion time used. To determine the difference of each level in the treatment given by comparing the p-value in table 4 with a significance level of 5% (0.05), in this case if the p-value is less than 5%, then there is a significant difference. From table 4 we can see that the immersion time of 4 hours and 12 hours there is a significant difference between the two. While the combination of immersion time 4 hours with 8 hours and 8 hours with 12 hours there was no significant difference.

Discussion

It has been previously reported that a chance in the colour of the acrylic resin plate soaked in the *Sargassum polycystum* granules effervescent denture cleaning agent for 10 minutes.[17] Previous studies have reported that *Sargassum polycustum* extract is able to inhibit the growth of *S. Mutans* and *C. Albicans*.[18]

The results showed that water immersion duration has an effect on reducing the compressive strength of acrylic resin plates. It can be seen that the compressive strength in water immersion with a time of 4 hours decreases at 8 hours and then decreases again at 12 hours. The average compressive strength of acrylic resin plates using water immersion is 32.81489 MPa. Immersion by using Polident cleaning agent influences the compressive strength of acrylic resin plates, it can be seen that the compressive strength at 4 hours decreases at 8 hours and then decreases again at 12 hours. The average compressive strength of acrylic resin plates using *Sodium Perborat* immersion is 35,111 MPa. Immersion by using *Sargassum Policystum* cleaning *agent* has the effect of reducing the compressive strength of acrylic resin plates, it can be seen in the compressive strength at 4 hours decreasing at 8 hours and then decreasing again at 12 hours. The average compressive strength of acrylic resin plates using sargassum immersion is 36,148 MPa. The type of cleaning agent *Sargassum Policystum* which has the largest compressive strength of acrylic resin plates that is equal to 36,148 MPa. Where the type of immersion material that has the smallest compressive strength of acrylic resin plates is using water immersion of 32.81489 Mpa.

Acrylic resins have the property of absorbing water so that they have the smallest compressive strength values, based on the results of research conducted by Ahmad Fuad in 2014, also thought to occur due to the total amount of phenol content found in *Sargassum Policystum* has a small value after sun drying, phenol compounds has properties that are sensitive to heat treatment, so the process of drying with sunlight can reduce the content of phenol compounds. Acrylic resin and phenol have different levels of polarity so it is not easy for both of them to react, based on the theory it can be concluded that the best cleaning agent for compressive strength of acrylic resin plates from the results of this study is *Sargassum Policystum.*

Conclusions

There was no change in the compressive strength of acrylic resin plates immersed in an *effervescent* granule denture cleaning agent *Sargassum policystum* 10% fraction. Cleaning Materials of granule *effervescent* fraction of *Sargassum policystum* 10% is better than *Sodium perborates.*

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Table 4.1. Compressive Strength Test Results with Water Immersion

Cleaning agent	Time (hour)	Sample	Length (L)	Width (W)	Thick (H)	Compressive Force (Fp)	Compressive Strength
			(mm)	(mm)	(mm)	(N)	(MPa)
	4	1	25	15	2	1080	36.000
		2	25	15	2	1208	42.667
		3	25	15	2	1260	42.222

Soaking Water	Score - Align						40.222
	8	1	25	15	2	840	28.000
		2	25	15	2	1120	37.333
		3	25	15	2	720	24.000
	Score - Align						29.779
	12	1	25	15	2	1220	40.667
		2	25	15	2	740	24.667
		3	25	15	2	600	20.00
	Score - Align						28.444

Source: data processed, 2019

Table 4 2. Compressive Strength Test Results with *Sodium Perborat* Soaking

Cleaning agent	Time (hour)	Sample	Length (L)	Width (W)	Thick (H)	Compressive Force (Fp)	Compressive Strength
			(mm)	(mm)	(mm)	(N)	(MPa)
Soaking *Sodium Perborate*	4	1	25	15	2	1200	40.000
		2	25	15	2	1120	37.333
		3	25	15	2	1100	36.667
	Score - Align						38.000
	8	1	25	15	2	1060	35.333
		2	25	15	2	1160	38.667
		3	25	15	2	1000	33.333
	Score - Align						35.778
	12	1	25	15	2	940	31.333
		2	25	15	2	940	31.333
		3	25	15	2	720	32.000
	Score - Align						31.556

Source: data processed, 2019

Table 4 3. Compressive Strength Test Results with *Sargassum Policystum* Immersion

Cleaning agent	Time (hour)	Sample	Length (L)	Width (W)	Thick (H)	Compressive Force (Fp)	Compressive Strength
			(mm)	(mm)	(mm)	(N)	(MPa)
Soaking Sargassum Policytum	4	1	25	15	2	960	32.000
		2	25	15	2	1180	39.333
		3	25	15	2	1360	45.333
	Score - Align						38.889
	8	1	25	15	2	1040	35.333
		2	25	15	2	1200	38.667
		3	25	15	2	1060	33.333
	Score - Align						36.667
	12	1	25	15	2	1140	38.000
		2	25	15	2	1100	36.667
		3	25	15	2	720	24.000
	Score - Align						32.556

Source: data processed, 2019

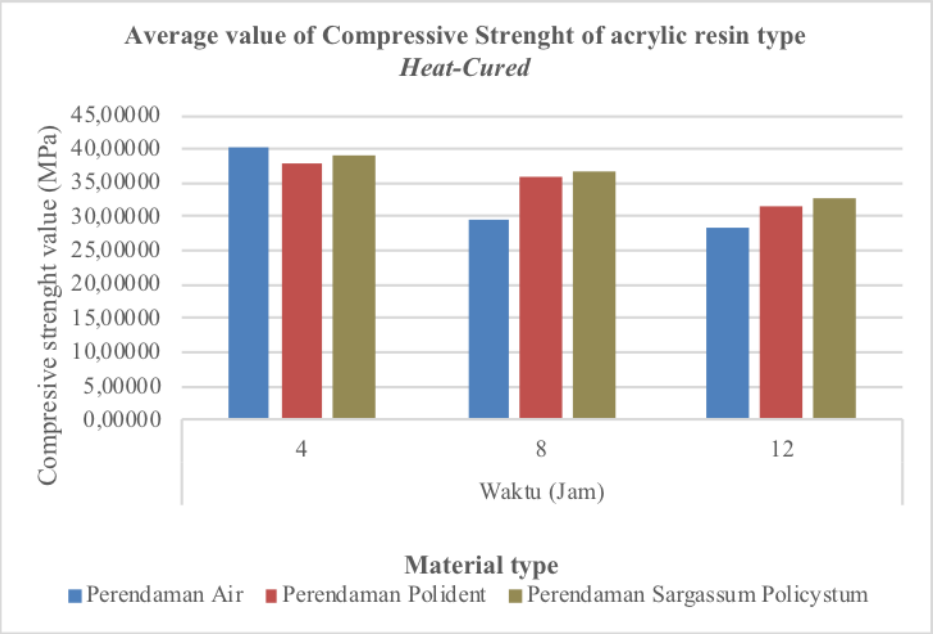

Figure 1. Average bar diagram of compressive strength values *of heat-cured* acrylic resin with variations in the time immersion in water, polydent and *Sargassum Policystum.*

Table 4.4 ANOVA Test

Source of Variation	Degrees of Freedom	Square Number	Average Squared	F	P-value
Types of cleaning agents	2	48.423	24.2115	0.723839	0.496
Soaking Time	2	296.497	148.2485	4,432113	0.027
Types of cleaning agents and long Time Immersion	4	74.54	18.635	0.557121	0.697
Error	18	602.077	33.444872		
Total	27	33517.73			

Source: data processed, 2019

Table 4.5. LSD test (*Least Significant Different*) type of cleaning material

Material Type	Water Immersion	Polident immersion	Sargasung immersion
Soaking Water	-		
Soaking *Sodium Perborate*	0.28	-	
Soaking Sargassum policystum	0.354	0.872	-

Source: data processed, 2019

Table 4.6. LSD test (Least *Significant Different)* length of immersion

Soaking Time	4 hours	8 hours	12 hours
4 hours	-		
8 hours	0.085	-	
12 hours	0.008	0.269	-

Source: data processed, 2019