Effect of *Sargassum Sp* effervescent on surface roughness of acrylic resin

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ABSTRACT
One type of denture cleaning is effervescent tablet. Brown algae effervescent granules (*Sargassum sp*) have been demonstrated as denture cleansers but it has not been proven whether these materials affect the surface roughness of acrylic resins. This research analyzes the effect of effervescent *Sargassum sp* and alkaline peroxide as a soaking agent on the surface roughness of acrylic resin plates. This laboratory experimental study with 27 samples of acrylic resin plates divided into three groups; A was immersed in effervescent granules, B was immersed in alkaline peroxide, and C was immersed in aquadest. Immersion was carried out for 15 minutes per day and lasted for 4 consecutive days; everyday each solution was replaced with a new one. Measurement of surface roughness and hardness of samples using Confocal Laser Scan Microscopy. Wilcoxon's test on the alkaline peroxide group showed a p-value of 0.008 ($p<0.05$) indicating a significant difference in surface roughness values before and after immersion. Paired t-test in the algae and aquadest groups showed $p>0.05$ which means that there is no significant difference in surface roughness values before and after immersion. It was concluded that *Sargassum sp* effervescent granule solution does not affect the surface roughness of the acrylic plate.
Keywords: surface roughness, *Sargassum sp*, effervescent

INTRODUCTION

The most commonly used denture base material is heat cured poly/methyl methacrylate acrylic resin. Acrylic resin is used because this material is non-toxic, non-irritating, insoluble in oral fluids, good esthetics, easy to manipulate, easy to repair and small dimensional changes. In addition to its beneficial properties, acrylic resin has disadvantages, namely the presence of residual monomers, is porous, absorbs water, and is less resistant to abrasion.[1] Water absorption by heat cured acrylic resin (HCAR) occurs by diffusion of water molecules into and spread between acrylic resin macromolecules so that the macromolecules separate. This is what can cause the surface roughness of the acrylic resin material which slowly over a certain period of time can penetrate the PMMA mass and occupy a position between the polymer chains so that the disturbed polymer chains are forced to separate. This absorption affects the physical properties of acrylic resin.[2]

Surface is a boundary that separates a solid object and its surroundings. Surface roughness is the irregularity of the surface texture, which generally includes the irregularities caused by treatment during the production process. The surface roughness of denture plates, especially acrylic plates, needs to be considered. The rough surface of the denture plate facilitates the accumulation of plaque and food debris, thereby increasing the *Candida albicans* colony which can cause *denture stomatitis.*[3]

Acrylic as a denture plate must have a smooth surface and minimum surface roughness because it can affect the health of the oral cavity tissue.[4] Clinically, the denture plate surface roughness threshold value is 0.2 m.[5] Surface roughness occurs on the HCAR plate, due to continuous use of the denture, causing some reactions to the tissue because the mucosa under the denture will remain for a long time. The rough surface of the denture plate makes it easier for plaque and food residue to build up so that it affects the level of oral hygiene of the patient and makes it difficult to maintain oral hygiene due to the continuous accumulation of plaque.[6,7]

Surface roughness in dentures can be a place for colonization of microorganisms that can injure oral tissues. Accumulation of food debris on dentures based on acrylic resin that is not cleaned can cause halitosis and adversely affect the health of oral tissues, it can also increase the number of microorganisms in the oral cavity such as the *C.albicans*.[8,9] *C.albicans* is opportunistic and can become pathogenic if the surrounding environment allows this fungus to multiply so that it can cause disturbance.[10]

Denture cleaning can be done by mechanical using a toothbrush and ultrasonic, and chemical techniques by immersing the denture in a disinfection solution such as alkaline peroxide, alkaline hypochlorite, chlorhexidine, sodium hypochlorite, enzymes and herbs. Chemical cleaning of acrylic resin dentures is more effective than mechanical methods, so cleaning agents that have bactericidal and fungicidal properties are needed, are easy to use,

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and are compatible with all denture materials.[11]

Along with developing of science, the use and utilization of herbal ingredients in Indonesia has progressed very rapidly. Herbal disinfectants are used by the community as an alternative of denture cleansers, in addition to the basic ingredients for denture cleaning in the form of chemicals that are developing in the market. The effectiveness of disinfectants from herbs has been widely studied and proven to prevent the growth of microorganisms found on denture plates.[12]

The government has announced the use of medicines derived from nature or herbs that can be obtained from cocoa pods (*Theobroma cacao l*). Cocoa pods are the largest waste produced by cocoa farmers and cultivators. Cocoa pods contain many bioactive components that can be used as dental therapy ingredients. Cocoa pod extract with a concentration of 0.25% can inhibit the growth of *Streptococcus mutans*, while a concentration of 6.25% can inhibit the growth of *C.albicans*.[13-15]

Utama, et al stated that there was a significant effect between solvent temperatures at 5-10°C, 20-25°C and 25-31°C denture cleanser effervescent granules of cocoa pod extract (*Theobromacacao l*) on the growth of *S.mutans* and *C.albicans*. The most influential temperature in inhibiting the growth of *S.mutans* and *C.albicans* is 20-25°C.[16]

Sargassum sp. brown algae is also one of the herbal ingredients that have antifungal and antibacterial properties so that it can be managed as a denture cleaning agent. In Choudhury's research, it was tested methanol extracts that of the three classes of seaweed, *Chlorophyta* (green algae), *Phaeophyta* (brown algae), *Rhodophyta* (red algae), *Phaeophyta* (brown algae) species had the highest antibacterial activity.[17]

Rosdiana cited by Afdila, shows that *effervescent* is considered more convenient to use as a cleaning agent compared to other preparations because it does not require large containers for storage, are more economical, easier to use, and the size and dosage are accurately measured.[18] *Effervescent* preparations can also be given to elderly people with decreased mobility.[19]

One of the herbal ingredients that has been proven to inhibit the growth of *S.mutans* and *C.albicans* is brown algae. Brown algae containing active compounds including flavonoids, alkaloids, saponins, phenols and triterpenoids have been shown to be able to inhibit the growth of *S.mutans* and *C.albicans* on acrylic plates with a concentration of 2.5% as cited in Utama and Ikhriyani's research on the effectiveness of effervescent granules from algae dechlorophyllization. Chocolate (*Sargassum polycystum*) in inhibiting the growth of *S.mutans* and *C. albicans* on acrylic resin plates.[20] Another herbal ingredient that has been proven is *Sargassum ilicifolium* or brown algae which is one of the genus *Sargassum* which belongs to the class *phaeophyceae*. *S.ilicifolium* contains Mg, Na, Fe, tannin, iodine and phenols have potential as antimicrobial agents. The active compound as antifungal from Sargassum seaweed is tannin.[21] Utama and Tetelepta in 2017, that one species of brown algae, *S. polysyctum* which contains active compounds including flavonoid, alkaloid, saponin, phenol and triterpenoid has been shown to be able to inhibit the growth of *S.mutans* and *C.albicans* on acrylic plates with a concentration of 2.5%.[22]

Effervescent is used as a cleanser, peroxide is provided in powder and tablet form. Materials containing alkaline compounds, detergents, sodium perborate and powder. When this material is mixed with water, the sodium peroxide perborate decomposes releasing oxygen. The cleaning is a result of the oxidizing ability of the peroxide decomposition and of the effervescent reaction to produce oxygen. It can effectively remove organic deposits and kill microorganisms. Alkali peroxide is a safe, effective method of denture cleaning and sterilization, particularly among geriatric patients.[23]

Confocal laser scan microscopy (CLSM) is a 3D surface roughness tester that serves to measure the roughness of a surface with standard or measuring properties of Rα, RZ, Rq, Rmax with an instrument accuracy of 0.02 m. The goal is to assess surface roughness using a laser indicator as a sensor to check the profile of the surface of the test object. This tool produces a graph and values and 3D images that can be viewed from various sides of the surface.[24]

Based on previous research, brown algae effervescent granules effectively inhibit the formation of *S.mutans* and *C.albicans* colonies on acrylic resin plates, this indicates the potential of effervescent granules to be an alternative to dentures. Therefore, the researchers wanted to find out more about the effect of 2.5% brown algae effervescent on the surface roughness of acrylic plate because it has an important role in the use of dentures.

METHODS

The samples of HCAR were 27 plates with a size of 10x65x3.3 mm for 3 treatment groups. Group I, solution of 2.5% sargassum effervescent granule extract, group II alkaline peroxide solution or sodium perborate, and group III aquadest. This acrylic

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resin sample was immersed in 2 mL of solution for each treatment group for 15 minutes/day at 24℃. After 15 minutes, it was removed and then washed with distilled water and dried on tissue paper and stored in a container to measure the surface roughness of the acrylic resin plate. All of the treatment groups were carried out for 4 consecutive days and each solution was replaced with a new solution everyday.

The samples were first measured using a surface roughness tester before immersion to see the roughness value before immersion. After immersion, the final surface roughness is measured using a surface roughness tester by 1) the sample is placed on a flat surface, and the operator placed the stylus at the point that has been made after immersion on the surface of the sample; 2) the tool is activated, the stylus moves along a straight line horizontally 8 mm long and back again; 3) measurements were made three times on each sample, then they were averaged as the final surface roughness value. This research conducted with ethical clearance no.UH 17120404.

RESULT

It was obtained data as shows in Table 1. The comparison between the mean values the results of the comparison of the three roughness groups shows a p-value more than 0.05, which means that there is no significant difference (Table 2).

Table 1 The mean and SD of the calculation of the surface roughness of HCAR for each group before and after immersion

Rudeness	Before	After
Alkaline Peroxide	0.0184±0.0019	0.0403±0.033
Algae	0.0170±0.0025	0.0164±0.022
Aquadest	0.0177±0.0028	0.0174±0.003

Table 2 Comparison of roughness between groups before treatment

	Alkaline peroxide	Algae	Aquadest
Alkaline Peroxide		0.223*	0.507*
Algae			0.569*

** LSD Test*

Table 3 Comparison of roughness between groups after treatment

	Alkaline peroxide	Algae	Aquadest
Alkaline Peroxide		0.000*	0.000*
Algae			0.452*

** Mann Whitney test*

Comparison of the roughness values of the alkaline peroxide, algae and aquadest groups after treatment, obtained from algae with aquadest using the Mann Whitney test, p-value > 0.05 (0.452) which means that there is no significant difference in the roughness value of the algae and aquadest groups. While the comparison of algae and alkaline peroxide and aquadest and alkaline peroxide showed a value of $p < 0.05$ which means that there is a significant difference in the roughness between algae and alkaline peroxide and aquadest and alkaline peroxide (Table 3).

Table 4. The difference in the mean and SD of the calculation of the surface roughness of HCAR before and after immersion

Rudeness	Before	After	p value
Alkaline Peroxide	0.0184 ± 0.0019	0.0403±0.033	0.008*
Algae	0.0170 ± 0.0025	0.0164 ± 0.022	0.285
Aquadest	0.0177 ± 0.0028	0.0174 ± 0.003	0.447

*p-value < 0.05 Wilcoxon & paired t test

The Wilcoxon test in the alkaline peroxide group showed a p-value of 0.008 ($p<0.05$), which means that there was a significant difference in surface roughness values before and after immersion. Algae and aquadest groups were analyzed by paired t-test showing $p>0.05$ (0.285 and 0.447) which means that there is no significant difference in surface roughness values before and after immersion in the algae and aquadest-immersed groups (Table 4 and Fig.1).

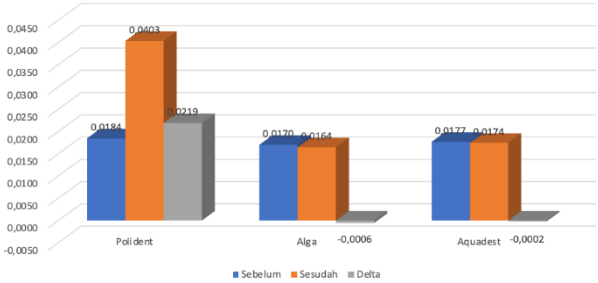

Figure 1 Histogram graph of the mean and SD of surface roughness of HCAR before and after immersion with alkaline peroxide, algae and aquadest.

DISCUSSION

On roughness examination, table 1 shows the average surface roughness value of acrylic resin for each group before and after immersion, indicating a change in the alkaline peroxide, algae, and aquadest groups as the control group. This is because aquadest is pure water with the assumption that it only contains H_2O molecules without the addition of other ionic elements and does not contain active substances that can accelerate the breaking of HCAR polymer chains. Aquadest has a lower effect on the surface roughness of HCAR compared to immersion using alkaline peroxide.[25] Table 2 is a comparison of roughness between groups before treatment, where the table shows an insignificant difference with p-value > 0.05.

Table 3 shows the roughness comparison between groups after treatment (immersion) where it can be seen that the comparison between the al-

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kaline peroxide group and the algae group and the alkaline peroxide group and the aquadest group shows a significant comparison value with p-value <0.05 where the roughness value in the polyden group is higher compared to other groups. This is also confirmed in table 4 which is the result of the comparison of the average surface roughness of acrylic resin before and after leaching (soaking) for each group, where the alkaline peroxide group before and after treatment showed a significant difference with the p-value<0.05 while the algae and aquadest groups did not show a significant difference. These results are in line with research conducted by Puspitasari which states that alkaline peroxide causes an increase in the surface roughness value of acrylic resin compared to 75% celery extract. This is because the chemical reaction of alkaline peroxide which dissolves in water produces sodium perborate and will break down into hydrogen peroxide, where this reaction will produce oxygen bubbles (nascent oxygen) which provide mechanical action to remove the biofilm layer from the acrylic resin surface.[26]

The results of this study are also supported by the statement of Jagger and Harrison cit Malheiros et al which states that oxygen bubbles released during this reaction can cause an increase in surface roughness. The oxidation reaction that releases oxygen causes the release of tertiary amines which further accelerates the oxidation reaction in the double bond of the resin matrix, resulting in physisical changes to the acrylic resin surface such as an increase in surface roughness.[26]

Table 4 also shows a decrease in the value of surface roughness in the acrylic resin group soaked with brown algae. Brown algae is an alternative to natural-based denture cleansers that can inhibit fungal growth. Sargassum sp contains Mg, Na, Fe, tannins, iodine and phenols which have potential as antimicrobial agents. The active compound as antifungal from Sargassum seaweed is tannin. This antifungal and antimicrobial ability has the potential to inhibit the formation of a biofilm layer which is the result of microorganism activity on the surface of the acrylic resin.[3]

It is concluded that the effervescent granule solution of Sargassum sp did not affect the surface roughness of the acrylic plate as well as the aquadest solution. Alkaline peroxide can affect the surface roughness of acrylic plate by increasing the acrylic surface roughness values. Immersion of acrylic resin plate in alkaline peroxide solution can significantly affect the surface roughness compared to acrylic resin plate immersed in Sargassum sp effervescent granule solution or aquadest as a comparison.

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