

Effect Of Immersion Of 6.5% Cocoa Peel (Theobroma Cacao L.) Effervescent Granule On The Hardness And Surface Roughness Of Heat-Polymerized Acrylic Resin Plate

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ABSTRACT

Introduction: Surface roughness is an important factor that directly affects the retention of bacterial plaque and stain. Daily use of denture cleanser can affect acrylic resin properties such as discoloration, surface roughness, hardness, and transverse strength; therefore, it requires alternative materials as denture cleaning materials. One of the alternative materials can be used as denture cleaners is 6.5% cocoa peel effervescent granules.

Objectives: To determine the difference between immersions of acrylic resin denture plate in effervescent granules of 6.5% cocoa peel and distilled water on surface roughness.

Materials and methods: This is true experimental study, the samples were 32 acrylic resin plates that had been soaked in distilled water and 6.5% cocoa peel extract effervescent granules, then the surface roughness was calculated using a confocal laser scanning microscope.

Results: Based on the results of Mann-Whitney U, the p value is 0.000 which is smaller than 0.05.

Conclusion: There is a difference between immersion in 6.5% cocoa peel effervescent granules and distilled water on surface roughness of acrylic resin denture plate.

Keywords: Effervescent granules, 6.5% cocoa peel extract, surface roughness, acrylic resin plate.

INTRODUCTION

Dentures are a part of prosthodontics, a subdivision of dentistry concerned with the maintenance of oral function, comfort, appearance and health of patients by replacing missing teeth and mucosal tissues with artificial teeth. A removable denture consists of base and artificial tooth elements. The ideal denture base material should have suitable physical characteristics such as good esthetics, biocompatibility, radiopaque and easy to repaired. The material that can be used as a denture base material is acrylic resin or often also referred to as polymethyl methacrylate. Until now, acrylic resin-based removable dentures are still the choice for denture fabrication.^{1,2,3}

The denture base is the part of the denture that rests on the soft tissues of the oral cavity and where the denture elements are incorporated. Denture base materials have biocompatible properties, easy to manipulate, easy to clean, do not dissolve in oral fluids and have high strength, rigidity, and hardness. It aims to develop a denture base material that has an effective function and good aesthetics.^{2,4}

Acrylic resin is a material used in dentistry as a denture base because it has good physical and aesthetic properties, low absorption, and easy to repaired. Acrylic resin denture base materials divided into three types based on the polymerization process.^{5,6}

Heat cured acrylic resin is the most widely used denture base material today. The thermal energy required for this material to polymerize is obtained by heating water in a water bath.²

The surface roughness of acrylic resin is an important property because an irregular surface increases the possibility of microorganisms remaining on the denture surface after cleaning. The surface roughness value is 0.2 μm . The surface roughness of acrylic resin is one of the most important factors in denture prostheses because it will determine before being used for denture users, moreover, surface roughness can cause discoloration of the prosthesis due to an uneven surface, making easier absorption of liquid, causing discomfort for the patient, and contribute to microbial colonization and biofilm formation.^{7,8}

There are 2 types of surface roughness measurement, i.e. contact type measurement, which occurs when there is contact between the tool and the surface being measured, and non-contact type measurement where there is no contact between the tool and the surface being measured during measurement.⁹ Effervescent granule is the result of a combination of acidic and basic compounds which when added with water (H_2O) will react to release carbon dioxide (CO_2), so that this effect will produce foam on the preparation. The raw materials in the manufacture of effervescent granules are sources of acids and bases. The most commonly used acid source is citric acid, while the most commonly used base source is sodium bicarbonate.¹⁰ 6.5% cocoa peel extract is the active ingredient added in the manufacture of effervescent granules, because based on previous research it was explained that 6.5% cocoa peel extract had the ability to inhibit the growth of *Streptococcus mutans* and *Candida albicans*. This is because cocoa peel contains phenolic compounds, flavonoids, tannins, and terpenoids, which are known to have antimicrobial activity.^{10,11}

METHODS

The is true experimental study and pre-post test with control group research design, which is measurement before and after giving treatment to the treatment group. The sample in this study was

part of a heat cured acrylic resin plate that had been made in the laboratory of the Faculty of Dentistry, Universitas Muslim Indonesia. The sampling technique used simple random sampling. This research was conducted at the Fishery Products Engineering Laboratory, Faculty of Marine and Fisheries Sciences, Hasanuddin University (production of 6.5 % cocoa peel effervescent granules), Laboratory of the Faculty of Dentistry, Muslim University of Indonesia (fabrication of acrylic resin plates) and Physical Metallurgy Laboratory, Faculty of Engineering, Hasanuddin University (roughness measurement of acrylic resin plates).

RESULTS

This study used 32 samples of acrylic resin plates soaked in distilled water and 6.5% cocoa peel extract effervescent granules to assess the surface roughness of acrylic resin plates. Based on the study, the following results were obtained:

Table 5.1 Surface roughness mean of acrylic resin plate immersed in distilled water

Roughness	Mean(μm) \pm SD	p-value
Before immersion	0,009 \pm 0,000	1,000
After immersion		

Note: *Wilcoxon analysis; p < 0, 05: significant

Table 5.1 shows that the average roughness value of acrylic resin plates before immersion was 0.009 μm and after immersion was 0.009 μm . The p-value of 1.000, which is greater than alpha 5% or 0.05, indicates that there was no significant difference before and after immersion in distilled water.

Table 5.2 shows that the average roughness value of acrylic resin plates before immersion was 0.009 μm and after immersion is 0.006 μm . The p-value of 0.000, which is smaller than alpha 5% or 0.05, indicates that there was a significant difference before and after immersion with 6.5% cocoa peel extract effervescent granules.

Table 5.2 Surface roughness mean of acrylic resin plate immersed in 6.5% cacao peel extract effervescent granules

Roughness	Mean(μm) \pm SD	p-value
Before immersion	0,009 \pm 0,000	0,000
After immersion	0,006 \pm 0,000	

Note: *Wilcoxon analysis; p < 0, 05: significant

Table 5.3 Mean difference of acrylic resin plate immersed in distilled water and 6.5% cacao peel extract effervescent granules

Roughness	Mean \pm SD	p-value
Distilled water	24,50 \pm 0,001	0,000

6,5% cacao peel extract effervescent granules	8,50±0,001
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Note: *Mann-Whitney analysis; p < 0, 05: significant

Table 5.3 shows that the average roughness value of acrylic resin plate immersed in distilled water was 24.50 and the average roughness value of acrylic resin plate immersed in 6.5% cocoa peel extract effervescent granules was 8.50 which is lower than distilled water. The p-value of 0.000, which was smaller than alpha 5% or 0.05, indicates that there was a significant difference between the roughness of acrylic resin plates immersed in distilled water and 6.5% cocoa peel extract effervescent granules.

DISCUSSION

The results showed that there was no significant difference in mean of surface roughness of the acrylic resin plate before and after using distilled water. This is presumably because distilled water is pure water that does not contain other ionic elements and does not have active substances that can affect the bonding of acrylic resins. Furthermore, it is not acidic, so it does not accelerate the termination of the polymer chain because acrylic resin is polymer in the form of long polyester esters consisting of low polarity repeating methyl methacrylate.

This study was supported by Puspitasari et al, 2016 which is in agreement to the research conducted, stated that heat cured acrylic resin soaked for 5 days using distilled water had a lower surface roughness. This is because distilled water is pure water with the assumption that it only contains H₂O molecules without the addition of other ions and does not contain active substances that can accelerate the breaking of heat cured acrylic resin polymer chains.¹²

This study showed that the immersion of acrylic resin plate in 6.5% cocoa peel effervescent granules obtained significant difference in mean surface roughness of acrylic resin plate before and after immersion. After immersion of 6.5% cocoa peel effervescent granules, the surface roughness of the acrylic resin plate decreased. This is considered influenced by the acid content contained in the effervescent granules tends to be lower than the base content, thus causing the release of not-induced plasticizer which results in increased surface roughness of the acrylic resin plate.

Contrary result by Sofya et al in 2020 showed the mean value of the surface roughness of heat-cured acrylic resin before immersion in dental cleaning tablets (Fittydent) was $0.023 \pm 0.014 \mu\text{m}$. The mean value of surface roughness of heat-cured acrylic resin after immersion in dental cleaning tablets containing 48% sodium bicarbonate was $0.027 \pm 0.02 \mu\text{m}$, there was an increase in surface roughness but not significant. Another study conducted by Ozyilmaz showed that foaming denture cleansers such as effervescent tablets increased the roughness of heat-cured acrylic resin plates but not significant.¹²

This study showed that there was a significant difference between the surface roughness of the acrylic resin plate immersed in distilled water and the effervescent granules of 6.5% cocoa peel extract. Immersing the acrylic resin plate with 6.5% cocoa peel extract effervescent granules resulted in a lower surface roughness value than the immersion of the acrylic resin plate in distilled water. The lower

surface roughness of the acrylic resin plate due to the use of 6.5% cocoa peel extract effervescent granules can prevent the attachment of microorganisms and can help resist plaque build-up, debris and stains. Furthermore, lower surface roughness make the acrylic resin plate more resistant to wear, has lower risk of coefficient of friction between the acrylic resin plate and the mucosa, and has a good effect on denture esthetics.

This research is supported by study conducted by Lubis and Dwi in 2019 which states that dentures with rough surfaces can cause bacterial plaque attachment. The attachment of microorganisms can cause bad breath, denture stomatitis, and various other complaints related to dentures. Surface roughness also affects aesthetics, color stability and biofilm formation. Rough surfaces wear out more quickly and have a higher coefficient of friction than smooth surfaces. Increased surface roughness has a detrimental effect on the esthetics of the denture.²

The results showed that the effervescent granules of 6.5% cocoa peel extract can be used as a denture cleanser compared to distilled water, because 6.5% cocoa peel extract effervescent granules were able to reduce the surface roughness of acrylic resin plates and have 6.5% cocoa peel extract which can help in inhibiting the growth of *Streptococcus mutans* and *Candida albicans* present on acrylic resin plates.¹³

CONCLUSION

Based on the results of the research conducted, it can be concluded that:

1. There was no difference of surface roughness before and after immersion of acrylic resin denture plate in distilled water (p-value 1,000).
2. There was a difference of surface roughness before and after immersion of acrylic resin denture plate in 6.5% cocoa peel effervescent granules (p-value 0.000).
3. There is a difference between surface roughness of acrylic resin denture plate immersed in 6.5% cocoa peel effervescent granules and distilled water (p-value 0.000).

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