

## The effectivity of tobacco leaf paste as denture cleanser to surface roughness of heat cured acrylic resin

Efektivitas pasta daun tembakau sebagai pembersih gigi tiruan terhadap kekasaran permukaan resin akrilik polimerisasi panas

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### ABSTRACT

Microporosity of acrylic resin can facilitate the colonization of microorganisms, causing denture stomatitis. Mechanical cleaning of dentures is effective for removing adhering microorganisms and plaque; electric toothbrush and denture cleaning paste. Using natural materials such as tobacco leaves is useful for minimizing the abrasive materials that can decrease surface roughness. The aim of this study was to determine the effectiveness of using tobacco leaf paste as denture cleanser to surface roughness of heat cured acrylic resin (HCAR). This experimental laboratory study and the posttest only control group design used 36 samples (65x10x2.5) mm, divided into 4 groups: control group is brushed without paste, group A brushed with HPAI herbal toothpaste, group B brushed with 50% tobacco leaf paste, and group C brushed with 75% TLP. It was showed that TLP was less effective as denture cleanser to surface roughness of HCAR. A 75% TLP recommended as denture cleaning paste.

**Keywords:** tobacco leaf paste, surface roughness, heat cured acrylic resin

### ABSTRAK

Porositas mikro resin akrilik memudahkan kolonisasi organisme mikro yang menyebabkan stomatitis gigi tiruan. Pembersihan gigi tiruan secara mekanis efektif untuk menghilangkan organisme mikro dan plak yang melekat; dengan sikat gigi elektrik dan pasta pembersih gigi tiruan. Penggunaan bahan alami seperti daun tembakau berguna untuk meminimalisasi bahan abrasif yang dapat menurunkan kekasaran permukaan. Penelitian ini ditujukan untuk mengetahui efektivitas penggunaan pasta daun tembakau sebagai pembersih gigi tiruan terhadap kekasaran permukaan resin akrilik polimerisasi panas (RAPP). Penelitian eksperimen laboratorium dengan rancangan *posttest only control group* menggunakan 36 sampel berukuran 65x10x2,5 mm yang dibagi empat yaitu kelompok kontrol yaitu menyikat gigi tanpa pasta, kelompok A menyikat gigi dengan pasta gigi herbal HPAI, kelompok B menyikat gigi dengan pasta daun tembakau 50%, dan kelompok C menyikat gigi dengan pasta daun tembakau 75%. Hasilnya pasta daun tembakau kurang efektif sebagai pembersih gigi tiruan terhadap kekasaran permukaan RAPP. Disimpulkan bahwa pasta daun tembakau 75% direkomendasikan sebagai pasta pembersih gigi tiruan.

**Kata kunci:** pasta daun tembakau, kekasaran permukaan, resin akrilik polimerisasi panas

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### INTRODUCTION

Since 1937, acrylic resin has been used as a base material for dentures. Heat cured acrylic resin (HCAR) is the most commonly used type of acrylic resin.<sup>1</sup> Acrylic resin absorbs liquids easily and has microporosity, affects the physical and mechanical properties of acrylic resin, such as surface roughness.<sup>2</sup> The nature of microporosity promotes microorganism colonization, which can lead to inflammation of the oral mucosa, such as denture stomatitis.<sup>3</sup> Cleaning dentures prevents microorganism colonization; there are various cleaning methods, including chemical, mechanical, and a combination. Chemical cleaning is less effective because prolonged soaking affects acrylic resin properties such as color stability and surface roughness. Mechanical cleaning is more effective because it takes less time, is easier to apply, and removes plaque more effectively. An electric toothbrush and cleaning paste are used for mechanical cleaning.<sup>4</sup>

Special denture cleaning pastes are not yet widely available in Indonesia.<sup>5</sup> The use of toothpaste as a cleaning agent is strictly prohibited because the abrasive ingredients contained in toothpaste can affect the physical properties of HCAR, namely increasing surface roughness above the ideal value that can be accepted by the oral cavity, which is 0.2 m.<sup>6,7</sup> Using natural ingredients, such as tobacco leaves, as an alternative to cleaning paste with good cleaning effect and low abrasiveness. Tobacco is a medicinal herb plant that has long been cultivated in Indonesia and has become the primary commodity used as a raw material in the manufacture of cigarettes. Tobacco leaves are used for their active compounds, which include alkaloids, flavonoids, tannins, and terpenoids. These active compounds have antibacterial and anticandida properties.<sup>8</sup> Tobacco leaf paste (TLP) brushed on HCAR with an electric toothbrush is intended to reduce the surface roughness value. The goal of this study is to see how effective TLP was as a denture

cleanser for HCAR against surface roughness.

## METHOD

This laboratory experimental research used posttest only control group design was carried out in the Faculty of Dentistry's Technology and Bioscience Lab, Faculty of Mathematics and Natural Sciences' Botanical Lab, Faculty of Pharmacy's Pharmacy Lab, and Faculty of Engineering's of Engineering's Materials Lab. The sample is in the form of a test plate of 65x10x2.5 mm. The treatment method involves soaking the 36 samples in sterile distilled water twice for 24 hours before separating them into 4 groups. The sample group consisted of the control group, which brushed for 22 minutes with an electric toothbrush but no cleaning paste, group A, which brushed for 22 minutes with an electric toothbrush and HPAI herbal paste, group B, which brushed for 22 minutes with an electric toothbrush and 50% TLP, and group C, which brushed for 22 minutes with an electric toothbrush and 75% TLP. The brushing time was calculated by adding together all of the brushing computations over the course of a year. Using a TR 220, the surface roughness of the HCAR plate was determined. Each plate was separated into three lines, and the three results were averaged to determine the surface roughness value.

The Shapiro-Wilk test and the Levene statistical test were used to assess the data from the results of the surface roughness test. To find significant differences between treatment groups, the one-way Anova parametric test was followed by the least significant difference test.

## RESULT

Using TLP as a denture cleaning agent for heat-cured acrylic resin against surface roughness was shown to be beneficial in a study that was separated into four groups. Brushing without denture cleaning paste was used in the control group. Group A received therapy using

**Table 2** LSD statistical test in all treatment groups on the average surface roughness of HCAR.

	Control	A	B	C
Control	-	0.248	0.324	0.443
A	0.248	-	0.863	0.060
B	0.324	0.863	-	0.085
C	0.443	0.060	0.085	-

HPAI herbal toothpaste (Herba Penawar Alwahida Indonesia); group B using 50% TLP; and group C using 75% TLP. Table 1 and Figure 1 show the results of the average surface roughness values in all sample groups.

After data collection, it is statistically evaluated to see if the data is homogeneous and normally distributed as well as to look for variations across treatment groups. The Shapiro-Wilk test was used to determine the data's normality that discovered that all treatment groups had significance values more than 0.05, indicating that the data were normally distributed. Because the significance value obtained for the homogeneity test using the Levene test was 0.200, which was larger than 0.05, the data were found to be homogeneous. The results of the two statistical tests demonstrate that the data is homogeneous and normally distributed, hence the one-way Anova test is carried out.

To determine whether there were significant variations between treatment groups, a one-way Anova test was performed. The significant value (Sig.) for the one-way Anova test is 0.194, which is Sig. 0.05, according to the results of the test. It may be inferred that the mean of the four sample treatment groups for the HCAR lime surface roughness was not significant or the same. The average difference between the treatment groups is the same, and the descriptive average difference is not significant, according to the LSD test, which is used to determine whether there are significant differences between each group. Table 2 below lists the outcomes of the LSD test.

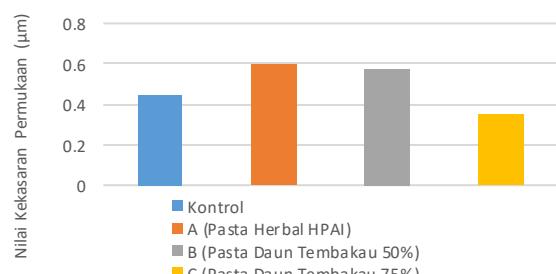
## DISCUSSION

The purpose of this sort of study was to test the efficacy of 50% and 75% TLP (*Nicotiana tabacum L.*) as a denture cleaning for HCAR against surface roughness. The efficiency of tobacco leaf-based denture cleaner paste was compared using HPAI herbal toothpaste. Each of the earlier research samples was polished on one side, brushed for 22 minutes, and then rinsed with clean water every minute. The different TLP concentrations are tested to see which one is the best at removing surface roughness from dentures made of HCAR.

The cleaning of acrylic resin plates in this study was carried out using a mechanical method which was effective and efficient enough to work as an antibacterial and anticandidal so that adequate cleaning could be achieved. Compared to other brushing techniques, the

**Table 1** The average surface roughness value of HCAR.

Group	Average(µm)	SD
Control	0,447	0,210
Group A (Placebo Paste)	0,598	0,339
Group B (TLP 50%)	0,575	0,235
Group C (TLP 75%)	0,348	0,107



**Figure 1** Bar chart of the average surface roughness values of HCAR.

mechanical cleaning approach requires less time to brush, making it more effective. Using a soft-bristled toothbrush and an electric brushing technique yields mechanical cleansing, whereas cleaning paste preparations with active tobaccoleaf chemicals yield chemical effects. Because an electric toothbrush uses electricity to drive the bristles in a continuous, horizontal and circular motion, they were used in this investigation. While horizontal motions are adapted to the often used tooth-brushing technique, circular movements are caused by the bristles' ability to move in circles. As with brushing natural teeth, the horizontal technique is most commonly used because it is easier to brush.<sup>9</sup>

Table 1 shows the surface roughness values obtained. It demonstrates that the acrylic resin and HPAI toothpaste brushing group had the highest average surface roughness value of acrylic resin plates, which was 0.598 m. The acrylic resin brushing group was then given a 50% concentration of TLP, which equals 0.575 m. The brushing group with 75% TLP had the lowest average surface roughness value on the HCAR plate, which was 0.348 m. The decrease in average surface roughness value was caused by an increase in TLP concentration. Brushing with a 75% TLP was more capable of producing lower surface roughness values than the control group, because the average value for the control group was 0.447 m. According to the average results of the four sample groups, 75% TLP is the most effective in affecting surface roughness when compared to lower concentrations and HPAI herbal toothpaste. When compared to the ideal value of surface roughness, which is 0.2 m, the 75% TLP still exceeds the ideal value of surface roughness that can be accepted by the oral cavity, so the TLP is thought to affect the physics of HCAR.

According to the calculations, 75% TLP is capable of producing lower surface roughness values than HPAI herbal toothpaste. This is due to the composition of TLP, which contains no abrasive particles, whereas HPAI herbal toothpaste contains various chemicals and preservatives not found in TLP.<sup>10</sup> The HPAI herbal toothpaste contains more abrasive ingredients. The average surface roughness value in the HPAI herbal toothpaste group was the highest. Abrasive wear is one of several factors that can affect the high surface roughness value.<sup>11</sup> Toothpaste contains abrasive ingredients, so when it rubs against a material, scratches form. In terms of composition, the more abrasive material used, the higher the resulting surface roughness value. When compared to TLP, HPAI herbal toothpaste has a higher concentration of abrasive ingredients. The same is true for the abrasive ingredient formulation in the 50% TLP, which contains more than the 75% TLP.

The release of residual HCAR plate monomer was another factor that influenced the surface roughness va-

lue in the control group. Even after going through all of the recommended manipulation processes, the release of residual monomer from acrylic resin is normal. This residual monomer is one of the causes of the formation of a rough and porous surface, which when tested increases the value of surface roughness and facilitates microorganism attachment. The second factor that causes an increase in the surface roughness values of some of the sample groups is that HCAR absorbs liquids easily. H<sub>2</sub>O will be absorbed around HCAR, affecting its mechanical properties. H<sub>2</sub>O affects mechanical properties via a diffusion mechanism that allows water to enter the polymer chain directly, causing polymer chain bonds to break from the acrylic resin. The fracturing of polymer chain bonds produces a clinically rough surface image.<sup>1</sup>

According to the research findings, the higher the concentration of TLP, the greater the value of surface roughness. Surface roughness was caused by several factors in the treatment group with 50% and 75% TLP, including direct contact between HCAR plates and chemical compounds found in tobacco leaves, specifically phenol compounds. When phenol in the form of flavonoids from tobacco leaves diffuses into the HCAR plate, it can damage chemical bonds. Flavonoids disrupt the functional group of their own bond with the HCAR polymer chain's C=O double bond. Contact with these compounds causes the release of hydrogen ions from the flavonoids, which will then bind to OH- ions originating from the ester group. Because the benzene group has lost many bonds along the way, it will bind to the ester group's RCO structure. Because there is empty space between polymers, it will be easy to bond between elements, causing the ester groups to separate, resulting in a chain imbalance and an increase in the surface roughness value of the HCAR plate.<sup>6,12</sup>

Chemical damage is another cause if acrylic resin comes into direct contact with acid. Because the ester group on the chain link reacts with the acid, hydrogen ions (H<sup>+</sup>) protonate the carbonyl group, causing the polymer chain from the HCAR plate to break. Acids can increase the surface roughness value of the plate due to the presence of acids and hydrogen ions which affect the chain bonds.<sup>3</sup>

Surface roughness is also caused by the brushing process, which requires direct contact between the bristles and the HCAR plate. The increase in surface roughness occurs because abrasion occurs on the surface during the brushing process as a result of the friction force generated by the rotation of the toothbrush and abrasive particles when in direct contact with the plate. Because the surface has softer properties, the abrasive material in toothpaste causes surface erosion, resulting in a high surface roughness value. Polishing and finishing techniques can also have an impact on surface roughness.

The different types of abrasive materials and the order in which the polishing techniques are performed have an impact on this polishing technique. The abrasive particle size will influence the degree of polishing and the resulting scratch pattern on the surface. Even if the abrasive is of high scale, fine particles produce the least amount of surface abrasion, whereas coarse particles, which have the most abrasive properties, can leave large surface scratches, making the surface more likely to produce high surface roughness values.<sup>13</sup>

The cleaning paste's abrasive ability is required to remove plaque and stains, but producing a higher surface roughness value than the ideal value accepted by the oral cavity will affect many physical properties. Theoretically, it shows that a denture base material's surface roughness value greater than 0.2 m can increase microorganism attachment to the denture surface. The results obtained were 50% TLP, 75% TLP, and HPAI herbal toothpaste brushed on HCAR plates, resulting in a surface roughness value greater than the ideal value.

The abrasive materials found in TLP in this study were magnesium carbonate and calcium carbonate. Both

substances are natural abrasives. Because the abrasive content of 50% TLP makes this paste less effective as a denture cleaning paste for the surface roughness of HCAR, the resulting surface roughness value is far above the ideal surface roughness value that the oral cavity can accept. Because it has a low surface roughness value, a 75% TLP can be recommended as an imitation of tooth cleaner. At 75% TLP still requires abrasive power to remove attached plaque, but the high content of abrasive ingredients must be controlled so that it is physiologically acceptable in the oral cavity. This study yielded 75% TLP, which has abrasive properties in small quantities but will not affect plate erosion.

It is concluded that 75% TLP produces the lowest surface roughness value. A 50% TLP is less effective as a heat-cured acrylic resin denture cleaner because it produces a surface roughness value far above the ideal surface roughness threshold. A 75% Nicotiana tabacum L., can be recommended as denture cleaning paste because it produces the lowest surface roughness value when compared to the other groups and has the abrasive power required by dentures.

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