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The effect of soaking blimbi (*Averrhoa blimbi*, L) fruit extract on the roughness of nanofiller composite resin

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Abstract

Background Nanofiller composite resin is a restorative material or filling material that is activated by visible light to restore anterior and posterior teeth. One of the characteristics of the composite resin surface is surface roughness. Surface roughness is greatly influenced by acidic solutions, namely the acid in drinks.

Objective: To determine the effect of soaking blimbi fruit extract (*Averrhoa blimbi* L.) on the roughness of nanofiller composite resin.

Research Method: Thisresearch uses laboratory experimental research**.** The sampling method used 6 sample groups in each group, consisting of 4 groups, namely 2 treatment groups and 2 control groups. The treatment group consisted of 50% and 100% blimbi fruit extract, then the control group consisted of a positive control grup (citric acid) and a negative control (aquadest). Then asurface roughness test was carried out on each group using a Surface Roughness Tester tool, then the test data was analyzed using the One-Way Anova test with the condition that the data had to be normal and homogeneous, the condition for the One-Way Anova test was that the sig value Sig <0.05.

Results: Based on analysis using One-Way Anova, the sig 0.518 (p>0.05), which means there are no significant differences in each sample group.

Conclusion: There is no influence on the roughness of the nanofiller composite resin by soaking in star fruit extract (*Averrhoa blimbi*, L) because the valuedifference is not significant.

Keywords: Nanofiller Composite Resin; Blimbi Fruit Extract; Surface Roughness Tester

1. Introduction

Nanofiller composite resin is a restorative or filling material activated by visible light to restore anterior and posterior teeth. Nanofiller composite resin has a tiny filler material size, so that nanofiller composite resin has the advantages of a smooth and shiny surface, smaller polymerization shrinkage, better durability, and also has low wear, so that today's nanofiller composite resin It has been widely used for posterior teeth. The advantages of this restoration material are low polymerization shrinkage, better mechanical strength, and a smooth surface (3). One of the characteristics of the composite resin surface is surface roughness. Surface roughness is greatly influenced by acidic solutions, namely the acid in drinks. Although this restorative material has advantages, the polymer in composite resin contains unstable

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bonds so that it can be degraded by acid (4). Blimbi (*Averrhoa blimbi* L.) is one of the many plants that is often used in traditional medicine. The pH degree of blimbi is 1-2 (5). Blimbi (Averrhoa bilimbi L.) is often used as a mouthwash because it contains antibacterial compounds to treat canker sores, mumps, coughs, bleeding gums, toothache, stomach ache, improves digestive function and overcomes fishy odors (10)(1). Even though it has acidic content, the blimbi (Averrhoa bilimbi L.) has many benefits which people use for dental and oral health, but it is necessary to remind patients who use composite resin fillings that they need attention because in Langen's research (2017) it is said that pH level of blimbi (Averrhoa bilimbi L.)

1.1. Nanofiller Composite Resin

Nanofiller composite resin is a composite resin that has been developed using nanotechnology, usually used to form products with component dimensions of around 0.1-100μm. The nanofiller composite resin filler component contains individual nanoparticles and nanoclusters. The combination of nanoparticles and nanoclusters reduces the space between particles, thereby increasing physical properties and better polishing results compared to other composite resins (11).

Nanofiller is also indicated for restoration of anterior and posterior teeth that are not in contact (12)(16). Then there are contraindications in patients with a high incidence of caries and patients who are sensitive to composite materials (16).

Nanofiller composite resins have been developed with a unique combination of individual nanoparticles and groups of nano-sized (5-20 μm) filler particles, which reduces the space between filler particles, resulting in better physical properties and polishing results compared to other composite resins (13).

1.2. Blimbi

Blimbi has a sour taste, the seeds are flat and contain a lot of water when cooked. Blimbi is often also called vegetable starfruit or sour starfruit because it tastes slightly sour and is often used as a cooking spice or herbal medicine, and is high in tannins, saponins, glucose sulfur, formic acid, peroxide, flavonoids and triterpenoids (15).

This plant is generally used by people as an additional ingredient to give a natural sour taste, but this plant is also widely used as an ingredient in traditional medicine to treat various diseases such as coughs, diabetes, rheumatism, mumps, canker sores, toothache, bleeding gums, acne, diarrhea and even pressure. high blood pressure (insan). Blimbi also contains high levels of acid with a pH value of 2. Some of the organic acids found in blimbi are acetic, citric, formic, lactic and oxalic acids (14).

Figure 1 Blimbi Fruit (7)

1.3. pH (Potential of Hydrogen)

pH or potential of hydrogen is the degree of acidity which is used to express the level of acidity or alkalinity of a solution. pH is defined as the cologritmaactivity of dissolved hydrogen (H+). Pure water is neutral, with its pH at 25 °C defined as 7.0. Solutions with a pH of less than seven are said to be acidic, and solutions with a pH of more than seven are said to be basic or alkaline (6).

1.4. Surface Rougness Tester

Surface roughness tester is a measuring tool that is useful for measuring the level of roughness on the surface of an object that has gone through the production process or been machined. Measurements on this tool are obtained from the movement of a diamond-shaped stylus signal that moves along a straight line on the surface of the workpiece which functions as a sensor for measuring the surface roughness of the test object (2).

2. Material and methods

This research method is a true experimental laboratory, with a post-test-only control group design. The materials used to make starfruit extract are starfruit and 96% ethanol solvent. Then the star fruit is mashed using a blender until it becomes simplicia powder. Then the simplicia powder was extracted using the maceration method for 5 days. The sample- making material used Filtek Z350 XT with a square box shape, measuring 10 mm x 10 mm with a thickness of 2 mm, totaling 24 pieces.

2.1. Making Nanofiller Composite Resin

The mold in the hole in the middle is smeared with vaseline using a small brush. Then the nanofiller composite resin is taken and inserted into the mold that has been smeared with vaseline using a plastic filling instrument. After that, the nanofiller composite resin mold is pressed using a cement stopper so that the nanofiller composite resin looks solid. Nanofiller composite resin is given a layer of celluloid strip on the top surface and exposed to a light curing unit for 20-30 seconds. Then the hardened specimen is released from the mold by pushing the specimen using a cement stopper.

2.2. Extraction Blimbi Fruit

Wash 1 kg of fruit with running water until clean then drain. Then after that the fruit is sliced and separated from the seeds using a knife with a thickness of approximately 0.5 mm. Then after that dry the fruit using the oven at 50°C. After that, it was crushed using a blender and sifted using a 60 mesh sieve, and obtained simplicia powder from the star fruit. Then the simplicia powder was weighed using an analytical balance. The ratio between ingredients and solvent is 1:7.5. A 500 g sample of star fruit simplicia powder was put into a 1000 ml Erlemeyer, then 67 ml of 96% ethanol solvent was added, then macerated at the appropriate temperature for 5 days. During extraction, stirring was carried out with a magnetic stirrer at a speed of 300 rpm. Next, it is filtered using coarse filter paper. The filtrate was collected (filtrate I) while the dregs were added with 96% ethanol solvent to a volume of 100 ml, stirred and filtered using coarse filter paper (filtrate II). Filtrates I and II were mixed and filtered using Whatman No. filter paper. 1. The filtrate is then evaporated with the solvent using a rotary vacuum evaporator at a temperature of 40°C, pressure 110 mbar with a speed of 100 rpm until all the solvent has been evaporated and a thick extract is obtained, namely 100% concentration of star fruit. Then, to obtain a 50% concentration extract from star fruit, a dilution process is carried out by giving it a dilution treatment using the formula:

$$V1.\ M1 = V2.\ M2$$

V1= Volume of solution required (ml)
M1 = Main solution concentration
V2= Desired volume
M2 = Desired concentration

2.3. pH Measurement

The degree of acidity of the water from the extraction of starfruit was measured using a pH meter.

Figure 2 pH Measurement

Before measuring pH, the pH meter is calibrated by inserting the electrode into distilled water with a pH of 7 until "ready" appears on the pH meter. After that, the electrode was inserted into the blimbi fruit extraction water 3 times. Then after that the average is calculated to obtain the pH value.

2.4. Soaking Nanofiller Composite Resin

Soaking the treatment samples, positive and negative controls using a cup and clean using a clean cloth. Then the treatment samples were soaked for 7 days using a cup covered with aluminum foil in an incubator for each treatment, namely with a concentration of 50% and 100%. Positive and negative control samples were also soaked for 7 days in a cup and covered. After that, it was removed and dried, then the surface roughness of the sample was tested using a Surface Roughness Tester.

2.5. Measurement of Surface Roughness of Nanofiller Composite Resin

The surface roughness of the nanofiller composite resin specimens was measured after treatment using a Surface Roughness Tester with 100x magnification and a range of 2 mm. The sample is placed on the measuring instrument table until the measuring needle can move freely to touch the surface of the sample being measured. The position of the sample is transverse with the direction of movement of the measuring needle parallel to the width of the sample. To control whether the measuring needle is touching correctly or pressing too much, it can be seen on the monitor screen. When the start button is turned on, the tool will move at a speed of 1mm/second. After the measurement is complete, the monitor screen will display data about the surface roughness of the sample, namely Rz, which shows the arimatic average of the five differences between the tip of the highest peak and the tip of the lowest peak of roughness formation, against the length of the surface measured in microns. The smaller the Rz value obtained indicates the lower surface roughness, and conversely the greater the Rz value obtained indicates higher surface roughness. The Rz graph taken for calculations must have a regular pattern (showing a flat surface). The average surface roughness (Rz) is obtained by dividing the measurement results into five parts, then for each part we look for the highest peak tip and the lowest peak tip that forms the roughness (Z) on the surface, then we multiply the calibration using the surface roughness formula:

$$Rz = \frac{Rz1 + Rz2 + Rz3 + Rz4 + Rz5}{5}$$

Rz = surface roughness
Z = number of highest peaks and lowest peaks

Figure 3 Surface Roughness Tester

3. Results and discussion

3.1. The Effect of Soaking Blimbi Fruit Extract on the Roughness of Nanofiller Composite Resin

The results of the roughness test of nanofiller composite resin is based on The treatment group used starfruit (*Averrhoa blimbi*, L) with concentrations of 50% and 100%, then the control group used distilled water as a negative control and 100% citric acid as a positive control group. It was found that the average value of the 4 sample groups, namely the positive control of 100% citric acid was 0.89 Rz, the negative control of distilled water was 0.60 Rz, the treatment group

used star fruit extract (*Averrhoa blimbi*, L) with a concentration of 50% with value 1.03 Rz and 100% concentration, namely 0.86 Rz.

Judging from the results of the One-Way Anova statistical test, it is worth 0.518, which means ($p>0.05$), there is no significant difference because according to the provisions of the One-Way Anova statistical test, it should be ($p<0.05$). So it can be concluded that the results are not in accordance with the hypothesis in this study or the hypothesis is rejected because there is no significant difference or no effect on the immersion of the 50% and 100% starfruit extract treatment groups, then on the positive control group (100% citric acid) and the negative control group (distilled water) because the three groups between the treatment groups were 50% and 100% starfruit extract, with the positive control (citric acid) having the same acid content.

3.2. Sample Total and Sample Type of Nanofiller Composite Resin

Factors that cause a hypothesis to be rejected include the number of samples and type of sample. The number of samples in this study was too small because there was a large standard deviation value. This is related to statistical testing and the type of sample in this study which used nanofiller composite resin with the brands Filtek Z350 XT, 3M ESPE, A3. This material uses a Bis-GMA and Bis-EMA matrix, which is a hydrophobic matrix and does not have hydrogen bond groups. Hydrophobic matrices are proven to show lower water absorption compared to composite resins which have hydrophilic matrices. The low level of water absorption is probably one of the causes of the absence of hydrolytic degradation which originates from the breaking of chemical bonds in the composite resin. This means that there is no decrease in the mechanical properties of the resin composites, including their hardness (9).

3.3. Effect of extract Dilution

The influence of the pH value of the acid. The pH of 50% starfruit extract has a higher acidic pH, namely around 0.58 compared to the acidic pH of 100% starfruit extract, which is around 1.25. This happened because the dilution of the 50% starfruit extract was carried out using 96% ethanol solvent, whereas the application used distilled water as a solvent. Distilled water itself is polar, but distilled water is distilled water which is free from impurities so it is pure in the laboratory. Aquades is also clear, odorless and tasteless (Khotimah et al., 2018). Ethanol solvent contains acids and bases. Ethanol solvent also has polar properties and is an excellent solvent when used as a preliminary extraction (17).

3.4. Sample Making Proses

Another factor that caused the hypothesis to be rejected in this study was due to the large standard deviation value in the statistical test results because the roughness level during the process of making the nanofiller composite resin samples was not the same. A standard deviation value that is too large can result in inaccuracies in the data so that if analyzed using the One-Way Anova test it is not significant.

Table 1 Surface Roughness Measurement Result

Surface Roughness Results (Rz)				
No	**Citric Acid100%**	**Aquadest**	**Blimbi FruitExtract 50%**	**Blimbi Fruit Extract100%**
1	2,30	0,67	0,67	1,13
2	0,27	0,27	1,27	1,13
3	0,30	0,73	0,63	0,73
4	0,70	0,73	1,63	1,27
5	0,73	0,20	0,70	0,23
6	1,03	1,03	1,33	0,67
Average	0,89	0,60	1,03	0,86

Based on table 1, It was found that the average value of the 4 sample groups, namely the positive control of 100% citric acid was 0.89 Rz, the negative control of aquadest was 0.60 Rz, the treatment group used blimbi extract (*Averrhoa blimbi*, L) with a concentration of 50% with value 1.03 Rz and 100% concentration, namely 0.86 Rz

Table 2 Shapiro-wilk Normality Test

Shapiro-Wilk			
Sample	**Statistic**	**df**	**Sig**
A. Sitrat 100%	0,817	6	0,083
Akuades	0,907	6	0,414
E. BW 50%	0,852	6	0,164
E. BW 100%	0,909	6	0,428

Based on the data from the normality testing results that have been carried out, it is known that the significance value of the treatment group blimbi extract (*Averrhoa blimbi*, L) with concentrations of 50% and 100%, then the positive control group was 100% citric acid and the negative control group was distilled water, all has a significance value of (>0.05). In the treatment group, blimbi extract (*Averrhoa blimbi*, L) with a concentration of 50% had a value of 0.164, at a concentration of 100% had a value of 0.428, the positive control group (100% citric acid) had a value of 0.083 and the negative control (distilled water) was 0.414, then it can be concluded that all the data is normally distributed.

Table 3 Levene-Test Homogeneity

Levene Statistic	**df1**	**df2**	**Sig.**
1.786	1	30	0,191

Based on the data homogeneity test given in Table 3, the significance value obtained is 0.191. Based on the provisions, if the significance value is > 0.05, it can be interpreted as the two groups coming from a homogeneous data population.

Because the assumptions of data normality and homogeneity of variance are met, the Independent T-test can be used with the results shown in table 4 below.

Table 4 One Way-Anova Statistical

Test Results	***Sum of Squares***	**df**	***Mean Square***	**F**	***Sig***
BetweenGroups	0,582	3	0,194	0,782	0,518
WithinGroups	4,964	30	0,248		
Total	5,546	23			

Based on the results of One Way-Anova parametric test show that the significance value is 0.518. From the provisions of the One-Way Anova test, if the data value is (>0.05), there is no significant difference in each sample group, namely the treatment group with blimbi fruit extract (*Averrhoa blimbi*, L) using a concentration of 50% and 100%, then the control positive (100% citric acid) and negative control (aquadest).

Table 5 Mean value and standar deviation

Sample Group		
Sample	**n**	**MeanValue**
Citric Acid 100%	6	0,89±0,74
Aquadest	6	0,60±0,31
Blimbi Fruit Extract 50%	6	1,03±0,42
Blimbi Fruit Extract100%	6	0,86±0,39

Based on the results of table 5. it was explained that each group had samples with a large standard deviation, this could occur when the process of making the nanofiller composite resin samples did not have the same roughness level. A standard deviation value that is too large can cause inaccuracies in the data so that the data analyzed using the One-Way Anova test is not significant. Statistically, a large sample size can obtain a mean and standard deviation which can have a high probability of resembling the population mean and standard deviation. In the 100% citric acid sample there was the largest standard deviation value is 2.30, in aquadest there was the largest standard deviation value is 1.03, 50% blimbi fruit extract, the largest standard deviation value is 1.63, and 100% blimbi fruit extract largest standard deviation is 1.27.

4. Conclusion

There was no influence on the roughness of the nanofiller composite resin by soaking in star fruit extract (*Averrhoa blimbi*, L) because the value difference was not significant. In the treatment group of star fruit extract (*Averrhoa blimbi*, L) 50% concentration had a mean of 1.03 Rz, 100% concentration had a mean of 0.86 Rz, then the negative control group (aquades) had a mean of 0.60 Rz and the positive control group (100% citric acid) has a mean of 0.89 Rz.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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