THE EFFECT OF SOATING JAVA ACID SOLUTION (TAMARINDUS INDICA L.) ON THE SURFACE ROUGHNESS OF MICROHYBRID COMPOSITE RESINS

Irsan IBRAHIM[1*], Anggieta BAYUPUTERI[2]
[1]Department of Dental Material, Science, and Technology, Faculty of Dentistry, Prof. Moestopo University, Indonesia.
[2]Bachelor of Dentistry Students, Faculty of Dentistry, Prof. Moestopo University, Indonesia.
**irsanibrahimmsi@dsn.moestopo.ac.id*

ABSTRACT

Introduction: Surface roughness can be affected by contact with an acidic solution. An acidic environment due to food and drink that is consumed continuously can be affected the instability of chemical bonds in the composite resin. Tamarindus indica or often known as tamarind is often used as herbal medicine, seasoning, syrup, and packaged drinks. **Purpose:** To determine the effect of tamarind solution on the surface roughness with immersion time of 1 day, 3 days, 5 days . **Methods:** This research was a laboratory experimental study, with a total sample of 27 microhybrid composites and conducted by measuring with a surface roughness tester. **Results:** There was a significant difference after immersion of tamarind solution on the roughness of the microhybrid composite resin. **Conclusion:** There is an effect of soaking tamarind solution (Tamarindus Indica L.) on the surface roughness until the 5th day.

Keywords: Microhybrid composite, Tamarindus indica L. drink, surface roughness

1. INTRODUCTION

Currently, the use of composite resins in the field of conservation dentistry continues to increase. Composite resin is used to repair tooth tissue lost due to disease or trauma and is useful for cementation of crowns, veneers and indirect restorations. One of the advantages of composite resin compared to other restorative materials lies in the aesthetic aspect, namely the shape and color that match natural teeth.[1,2,3]

The durability, aesthetics and long-term clinical success of dental restorations are related to one of them, namely surface roughness. The surface roughness of composite resin can be influenced by several things, namely the hardness of the toothbrush bristles, pH or the amount of toothpaste used and contact with acidic solutions. Bollen's (2007) research states that the clinically acceptable surface roughness value of dental materials in the oral cavity is less than 0.2 μm and the surface roughness has a normal value of 0.09 μm. An acidic environment resulting from food and drink consumed continuously that has an excess of H+ ions causes chemical bond instability in the composite resin, causing degradation. This degradation causes the release of resin matrix monomers which causes the release of inorganic fillers which will cause filler bulges, causing the surface of the composite resin to become rough.[4,5,6,7]

As technology advances, composite resin materials are developing with a combination of two different filler sizes, one of which is a microhybrid type composite resin which is expected to minimize shrinkage. Microhybrid composite resin has a combination of glass microparticles measuring 0.04 – 1 μm and silica microfillers measuring 0.04 μm. Microhybrid composite resins are advantageous because they can be applied easily, and exhibit excellent mechanical properties.[8,9]

Tamarindus indica or what is often known as tamarind is a multifunctional plant that is often found in Indonesia, especially on the island of Java. The uses of tamarind that are often found are herbal medicine, cooking spices, syrup, and even packaged drinks. People use tamarind to treat stomach aches, diarrhea, dysentery, treat wounds, antimicrobial, anti-diabetes mellitus, anti-cholesterol, analgesic, anti-obesity and antioxidant. Tamarind fruit contains the highest levels of protein and carbohydrates compared to various other fruits and contains various organic acids including tartaric acid, acetic acid, citric acid, acetic acid, formic acid, malic acid and other ingredients. Based on research by Purnomo et al. (2018), the pH of tamarind is 2.50, not much different from lime which contains citric acid and has a pH of 2.48-2.5.[10,11,12,13]

Several studies have proven changes in the surface roughness of composite resins due to immersion in acidic drinks. The effect of acid drinks on restoration materials not only depends on the chemical composition (type of acid) of the drink but also the amount, frequency of consumption, and length of contact with the acid drink. Based on research conducted by Tandyuana et al. (2017), nanohybrid composite resin soaked in lime juice for 30 hours had a rougher

eISSN 2622-5611
DOI: 10.33068/iccd.v5i1.608

surface and research by Gouvea et al. (2011), also showed that various composite resins soaked in coffee with a pH of 5.01 for 15 days experienced an increase in roughness. According to research by Nurmalasari (2015) which compared the surface roughness of nanofiller composite resin soaked in black tea and coffee, it showed that the surface roughness of nanofiller composite resin soaked in coffee was higher, which was caused by the higher acid content in coffee.[1,3]

The results of a study conducted by Bang et al. (2006), showed that restoration material soaked in orange juice with a pH of 3.85 experienced an increase in surface roughness after being soaked for 24 hours, 1 week, 2 weeks then experienced a decrease in roughness in the third week and increased again in the fourth week. From these results it can be seen that the longer soaking time does not guarantee that the surface roughness will increase. Similar to research conducted by Sindy et al (2020), it showed that nanofiller composite resin had no significant change in roughness after being soaked in yogurt drink for 12, 24, 36 hours. [3, 14]

Based on the description above, because there are differences in the results of research conducted by several researchers, researchers are interested in examining the effect of tamarind (Tamarindus indica L.) solution on changes in surface roughness of microhybrid composite resin after soaking.

2. METHODS

The type of research used in this research is laboratory experimental and the research design used is Pre Test - Post Test Group Design. The sample in this study used a microhybrid composite (ivoclar te econom plus) which was made from a block-shaped acrylic mold with a length of 10 mm, width of 10 mm, thickness of 2 mm and was activated using the light curing method.

In this study there were 3 working groups with each group consisting of 9 specimens per treatment to be examined, so that the total specimens to be used were 27 specimens. The first group was the treatment group soaked in tamarind solution for 1 day, the second and third groups were the treatment groups soaked in tamarind solution for 3 and 5 days. First clean the acrylic mold from dust, grease the mold using Vaseline to make it easier to remove the specimen. At the bottom of the mold, line it with a celluloid strip. The microhybrid composite resin is placed into the mold using plastic instruments then compacted and coated with celluloid strips. Expose it for 20 seconds using a light curing tool, the radiation is carried out in a direction perpendicular to the surface of the specimen at a distance of 2 mm. Then let the specimen sit for 24 hours. After that, the specimen is removed from the mold.

Prepare 200 grams of Gunung brand tamarind fruit and 1 liter of water. Boil water and tamarind until it boils. Once boiling, turn off the stove and let cool until completely cold. Strain the tamarind solution with a filter and put it in a container. Before soaking, the tamarind solution is measured using a pH meter. All microhybrid composite resin specimens had their surface roughness measured using a surface roughness tester with the TIME 3221 brand. The measurements were carried out twice, namely before immersion and after immersion in tamarind solution.

Measurements are carried out by placing the specimen in a mold so that it is in a stable position when measuring. Then the surface roughness test detector is placed on top of the specimen at a 90o angle. The tip of the stylus is to the surface of the composite specimen with a distance of 2.5 mm, and then the surface roughness measuring instrument will move with a speed of 0.5 mm/s and a pressure of 0.8 mN on the surface of the specimen. Record the results of each measurement taken and calculate the average value.

3. RESULTS & DISCUSSION

The results showed an increase in surface roughness of the microhybrid composite resin after being soaked in tamarind (Tamarindus indica) solution.

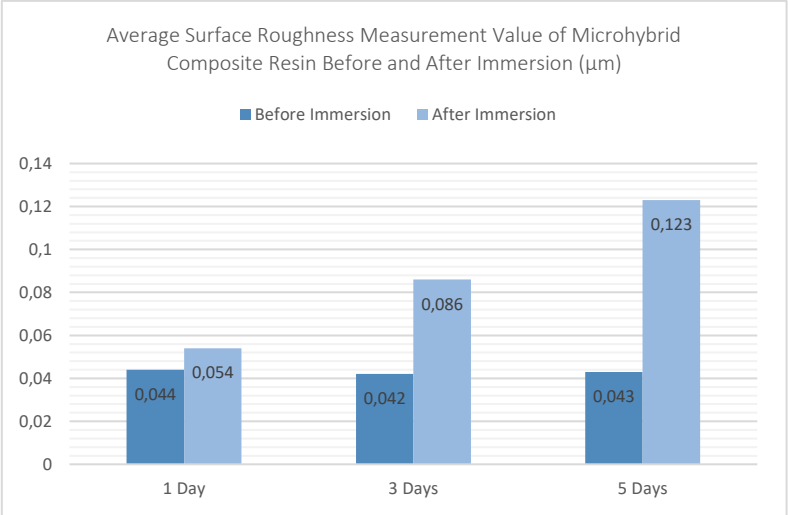

Figure 1. Diagram of the average surface roughness measurement value of microhybrid composite resin before and after immersion.

The results of descriptive data analysis of the surface roughness of the microhybrid composite resin before immersion in tamarind solution for 1 day was 0.044 µm, immersion for 3 days was 0.042 µm and immersion for 5 days was 0.043 µm. The results of surface roughness measurements after soaking in tamarind solution for 1 day were 0.054 µm, soaking for 3 days was 0.086 µm and soaking for 5 days was 0.123 µm.

The results of the Shapiro-Wilk test show that all sample groups are normally distributed because the p value is> 0.05. In the Levene Test, the value obtained was p = 0.008 (p<0.05), which means the research data was not homogeneous. To see the significance of differences across treatment groups, the Kruskal-Wallis test was carried out (Table 1). The results of this test provide a significance value of p=0.000 (p<0.05), which means there are differences in the three groups.

Table 1. Kruskal-Wallis Test Analysis of Changes in Roughness After Immersion for 1 Day, 3 Days, 5 Days.

Variable	1 Day	3 Days	5 Days
1 Day		p = 0.000*	p = 0.000*
3 Days	p = 0.000*		p = 0.000*
5 Days	p = 0.000*	p = 0.001*	

*Sign p < 0.05

From table 1 it can be seen that there are significant differences between groups. Significant differences between the 1 day, 3 day and 5 day immersion groups (p<0.05).

Tamarind (Tamarindus indica L.) is a fruit that is easy to obtain and is commonly used by people as traditional medicine. Every part of the tamarind tree is useful in medicine. Tamarind fruit can be used to improve digestion, colds and other health problems. However, tamarind solution has an acidic pH which according to research by Purnomo et al. (2018), the pH of tamarind is 2.50.[13,15]

Microhybrid composite resin is a type of composite resin developed to increase the durability of composite resin in the mouth. Microhybrid composite resin contains a mixture of micro particles (0.04 to 1.0 µm) and microfine particles (0.01 to 0.1 µm). Microhybrid composites contain high filler content (70% by volume) which can improve the physical properties of the composite resin. [12, 2]

This research was conducted to see how the roughness test results of microhybrid composite resin were after being soaked in tamarind solution for 1, 3, 5 days. 1 day of immersion is assumed to be equivalent to consuming tamarind solution for 9.6 months with the time spent drinking tamarind solution once generally 5 minutes. Soaking for 3 days and 5 days is comparable to consuming tamarind solution for 28.8 months and 48 months.[3]

The research results showed that there was an effect of soaking before and after soaking in tamarind solution (Tamarindus indica L.) on increasing the roughness of the microhybrid composite resin (sign = 0.000). The average

surface roughness value of the microhybrid composite resin before immersion in tamarind solution (Tamarindus indica L.) was 0.043 and the average value after immersion in tamarind solution (Tamarindus indica L.) was 0.087. The results of data analysis using the paired t-test showed that there was a significant difference between the roughness before and after soaking, and after analyzing the data using the Kruskal-Wallis test, it showed a significant difference between the roughness after soaking for 1, 3, 5 days.

In this study, researchers used *Te econom plus* composite which has a composition of dimethacrylate and TEGDMA (22% wt), filler barium glass, ytterbium trifluoride, silicon dioxide, and mixed oxide (76% wt or 60% by volume), and additional compositions namely additives, initiators, stabilizers and pigments. In research by Atmaja (2022), it is stated that degradation of the resin matrix can be caused by water diffusion. In acidic conditions, the water absorption properties of composite resin can cause filler particles to be released and the resin matrix to be damaged. BisGMA and TEGDMA experience hydrosis, this is because they have hydroxyl groups so they can absorb more water. The more water absorbed by the composite resin, the greater the possibility of decreasing the quality of the composite resin. In this study, there may be an increase in roughness after being immersed in an acid solution due to the water absorption properties of the composite resin.[16]

Tamarind solution contains organic acids including tartaric acid, acetic acid, citric acid, formic acid, malic acid and succinic acid. Based on measurements carried out by researchers, the tamarind solution has a pH of 2.5. The increase in roughness after soaking in an acid solution in this study is in line with research conducted by Tandrayuana (2017), regarding the increase in roughness of nanohybrid composite resin soaked in lime juice (Citrus aurantifolia Swingle) which has a pH of 2.51 for 2.5 hours, 15 hours, and 30 hours. The acid content in tamarind solution and lime juice is similar and makes these two solutions both have a chemical structure with lots of H+ ions. The excess ion causes the chemical bonds of the double chain polymer composite resin matrix to become unstable. This instability is caused by bonds with H+ crosslink ions, so that the double bonds of the matrix polymer are broken. The dissolved composite resin matrix will leave filler protrusions. Filler protrusions can cause roughness of the composite resin. In this study, there was an increase in the roughness of the microhybrid composite resin which could possibly be caused by the pH of tamarind which had a value of 2.5.[3,7]

The increase in roughness in this study may also be influenced by the length of soaking as in Camilotti's (2022) research. Camilotti (2022), stated that the pH of the oral cavity environment and the contact time of the solution have a large influence on the surface degradation of restorations. The mechanism that can occur is degradation of the composite matrix due to the entry of acid solution into the matrix, causing an increase in volume in the matrix. The increased volume will result in the formation of pores in the composite material and cause the release of the matrix monomer. The longer the composite is in the acid solution, the hydrolysis process will occur continuously and the formation of pores in the composite will increase.[3,7]

In this research, when polymerizing the microhybrid composite resin, mylar strips were used to produce a smooth surface. A number of studies, such as research by Farahat (2019), Bansal (2019) and Soliman (2021), show that a smooth composite surface can be achieved by using mylar strips. In research by Yilmaz (2021), polished surfaces can cause surface irregularities that allow solutions to enter the polymer matrix, then cause destruction of the composite resin.[17,18]

The use of microhybrid composite resin as an anterior and posterior restoration material) accompanied by regular consumption of tamarind solution for a period of 9.6 months - 4 years can cause roughness of the composite resin surface. It is important to maintain a smooth composite surface to avoid problems such as discoloration and brightness and minimize the risk of secondary caries. Rough surfaces can result in the buildup of bacteria and can affect periodontal health.[19]

4. CONCLUSION

Based on the results of research that has been carried out regarding the effect of soaking in a solution of tamarind (Tamarindus indica L.) on changes in the roughness of microhybrid composite resins, it was concluded that immersion in tamarind solution affects the surface roughness of the microhybrid composite resin and surface roughness of microhybrid composite resin is caused by acid, water absorption properties of the resin, soaking time, and degradation.

5. REFERENCES

Diansari V, Sungkar S, Hardiyanti CR. (2019). Studi Kekasaran Permukaan Resin Komposit *Nanofiller* setelah Perendaman dalam Seduhan Kopi Arabika Gayo. J Syiah Kuala Dent Soc. 4(2), Hal: 31

Shen C, Rawls HR, Esquivel-Upshaw. (2012). *Philip's Science of Dental Materials*. 13 th Ed. St. Louis, Missouri: Elsevier, p. 277, 280, 287.

Tandrayuana, Arif Prasetyo, Setyabudi. (2017). Perbedaan lama perendaman air perasan jeruk nipis *(Citrus aurantifolia Swingle)* terhadap kekasaran permukaan resin komposit *nanohybrid.* Concervative Dentistry Journal. , 7(1) : 43-47

Taraboanta, Geletu, Stoleriu, et al. (2022). *In Vitro Evaluation of Gastric Acid and Toothbrushing Effect on the Surface State of Different Types of Composite Resins*. Medicina.

Sari, Ningsih, Soraya. (2016). Pengaruh Konsentrasi Ekstrak Kayu Manis *(Cinnamomum Burmanii)* terhadap Kekasaran Permukaan Resin Akrilik *Heat Cured*. J Syiah Kuala Dent Soc., 1(2): 134

Viodetta, Susanto, Tanjung. (2021). Pengaruh Perendaman Air Perasan Jeruk Lemon dan Asam Cikala Terhadap Kekasaran Permukaan Resin Komposit *Nanofiller.* Jurnal Ilmiah Kesehatan sandi Husada, p. 224

Diansari, Sundari, Dani. (2022). Kekasaran Permukaan Resin Komposit Nanofiller setelah Paparan Perasan Jeruk Nipis *(Citrus aurantifolia).* Cakradonya Dent J., 14(1)

Istikharoh F. (2018). Dental Resin Komposit : Teori, Instrumentasi, dan Aplikasi. Malang: UB Press., p. 39

Putri JNS, Elline E. (2021). *Diametral Tensile Strength of Microhybrid and Nanohybrid Composite Resins.* Journal of Indonesian Dental Association (JIDA).: 4(1). Hal: 42

Silalahi M. (2020). Bioaktivitas Asam Jawa *(Tamarindus indica)* dan Pemanfaatannya. Florea Jurnal Biologi dan Pembelajarannya.; 7(2):85-91

Zain HH, Harniati ED. (2020). Pengaruh Produk Minuman Asam Jawa *(Tamarindus indica L.)* terhadap Kekerasan Permukaan Resin Komposit Nanohibrid. JMKG.;9(2): 58

Putri CRH. (2014). Potensi dan Pemanfaatan *Tamarindus indica* Dalam Berbagai Terapi. Jurnal "Ilmiah Kedokteran".; 3(2): 41

Purnomo, Surjoseputro, Setijawati. (2018). Pengaruh Konsentrasi Asam Jawa *(Tamarindus Indica L.)* Terhadap Sifat Fitokimia dan Organoleptik Pulp Kulit Pisang Kepok-Asam Jawa. Jurnal Teknologi Pangan dan Gizi.;17(1):51-57

Ningrum SW, Agustiono, Harsini. (2020). *Surface Roughness and Colour Changes of Nanofilled Composite Resin After Immersion in Yogurt Drink*. Majalah Kedokteran Gigi Indonesia.; 6(3): 152

Al Jobouri AHA. (2020). *Studying Some The Fuctional Properties of Tamarind Tamarindus indica L. Mucilage*. Al-Qadisiyah Journal for Agriculture Sciences (QJAS).; 10(2): 304

Atmaja, Harniati, et al. (2022). *The Effect of Robusta Coffee Immersion on the Surface Roughness of Hybrid Composite Resin. Atlantis Press.*

Szczepaniak, Krasowski, Rzepkowska. (2022). *The Effect of Various Polishing Systems on the Surface Roughness of Two Resin Composites—An In Vitro Study.* Coatings.

Yilmaz E, Mujdeci A. (2021). *The Effect of Mouthrinses of Surface Roughness of Two Nanohybrid Resin Composites.* Brazilian Dental Science. ; 24(2): 9

Nemeth, Haluszka, Seress, et al. (2022). *Effect of Air-Polishing and Different Post-Polishing Methods on Surface Roughness of Nanofill and Microhybrid Resin Composites.* Polymers. 2022