International Journal of Medical Science and Clinical Invention 10(2): 6543-6547, 2023
DOI:10.18535/ijmsci/v10i2.01
https://valleyinternational.net/index.php/ijmsci

Original Research

The Effect of Lemon Tea Immersion on Surface Roughness of Nanofiller Composite Resin

Mirna Febriani[1], Herlin Amelia[1], Tuti Alawiyah[1], Emma Rachmawati[2]

[1]Department of Dental Material, Faculty of Dentistry, University of Prof.DR. Moestopo (Beragama),Jakarta, Indonesia
[2]Department of Oral Biology, Faculty of Dentistry, Universitas Padjadjaran, Bandung, Indonesia
Email Address: **mirnarifky@dsn.moestopo.ac.id**

Abstract

Background: Consumption of lemon tea as a preventive measure against diseases due to its various benefits. Lemon tea has acidic properties. Nanofiller composite resin is one of the restorative materials, polymer is one of the content of restorative materials, and polymers have unstable bonds so that they can be degraded by acids or low pH. The degradation of polymer components and fillers from restorative materials will affect the roughness of the restoration surface. Methods: The sample amount is 24 nanofiller composite resins soaked in lemon tea. This study was conducted by measuring the roughness level of nanofiller composite resins with surface roughness testers. Result: There was an increase in surface roughness of nanofiller composite resins soaked in lemon tea ($p<0.05$). Conclusion: There is a roughness effect on the nanofiller composite resin soaked in lemon tea solution for 24, 48, 72, and 96 hours.

Key Word: Lemon tea, Nanofiller, Composite Resin

Introduction:

A study by the Institute of Africa and Diaspora Studies (IADS) and the Nigeria Institute of Medical Research (NIMR) showed that Nigerians use African Traditional Medicine as a prelude to COVID-19 prevention. Common natural supplements used by Nigerians are lemon (Citrus lemon), ginger (Zingiber officinale), garlic (Allium sativum L.), and turmeric (Curcuma longa). Lemon juice contains carboxylic acid (R-COOH) which can regulate blood circulation and high blood pressure, reduce blood clothing, and protect narrow arteries. Drinking plenty of lemon tea helps stimulate the human body to produce immune system cells-antibodies. Lemon slices drunk with warm water can effectively kill malignant or cancerous cells without affecting healthy cells. It can eliminate the coronavirus in the early stages before it reaches the lungs. Therefore, covid-19 patients/victims can recover from viral infections, especially when
the symptoms are mild, when treated with this lemon extract in the early stages of infection of the human body system.[1] Lemon fruit liquid is known to consist of 5% citric acid which gives a distinctive taste to lemons and has a pH level of about 2-3 and is known to have an analgesia effect.[1-4] The acid consumed will have an effect on the oral cavity, including the restoration of the teeth. The restoration material commonly used in anterior and posterior teeth is a composite resin because it has aesthetic advantages and strength. In composite resin restoration materials, the polymer of such materials contains unstable bonds. so it can be easily degraded by acids or low pH. In addition, resistance to degradation inside the oral cavity is very important so that the restoration material can last for a long period of time. The degradation of polymers and filler components in composite resin restoration materials will affect the roughness of the restoration surface.

Rough restoration surfaces can cause a build-up of dental plaque that will damage soft tissues as well as periodontal tissue, lower the brightness of the restoration, and are prone to discoloration and surface damage.[5,6]

Acid is not only contained in tea, other ingredients

that contain acid one of them are lemon and lime. In another study, it was said that there were differences in surface roughness in nano composite materials in black tea and coffee soaking, it was said that the surface roughness that occurs in nano composite resin materials is higher in coffee than in black tea. The main problem that most often affects the resistance of materials is chemical degradation due to exposure to acids, plaques, food, enzymes, ion composition in saliva which results in softening of the restoration material thereby degrading physical and mechanical properties. Another acid-containing ingredient is coffee.[7-9]

Tea molecule is believed to be able to penetrate deeper in composite resin materials than coffee molecules. Coffee molecules are found only on the surface of composite resin materials.[10] In the same study, finishing and polishing are important steps in the placement of direct restoration, the same as the factors that have an effect on staining. Surface roughness is also caused by the size of the filler, where the smaller the filler size, the smoother the surface that can be achieved after the polishing process.[11]

Composition and particle size of the filler have an effect on the surface roughness of the composite resin and it is possible that nanocomposites with smaller particles will have a smoother surface roughness and will result in less stains on the surface of the composite resin.[12]

Methods:

The type of research used in this study was experimental with a design using Post Test Only Group Design. The samples used in this study were nanofiller composite resins in the form of blocks with a size of 5mm x 5mm x 2 mm soaked in lemon tea solution for 24, 48, 72, and 96 hours. A solution pH acidity test was carried out and tested for roughness using a stylus surface roughness tester profilometer.

Result:

The roughness group of nanofiller composite resin soaked in lemon tea solution for 1 day/24 hours showed data that was not normally distributed ($p=0.014<0.05$), while for the other roughness groups the data were normally distributed ($p>0.05$). Furthermore, for homogeneity tests using the Levene's test, a p-value or sig is obtained < 0.035 which states that H_0 is rejected so it can be said that the variations between variables are relatively unequal.

Table 1. Average Value of Composite Roughness of Nanofills after Soaking for 24 hours, 48 hours, 72 hours, and 96 hours of soaking.

Treatment	Mean ± SD	Min-Max
1 day/24 hours, blue color	0.035 ± 0.034	0.01 - 0.10
2 days/48 hours, green color	0.320 ± 0.22	0.08 - 0.67
3 days/72 hours, orange color	0.197 ± 0.176	0.02 - 0.47
4 days/96 hours, white color	0.216 ± 0.177	0.03 -0.48

Table 2. Results of the Shapiro Wilk Test Normal Distribution Test and data homogeneity test with levene test.

No	Treatment	Normality Test (p* value)	Interpretation	Homogeneity Test (P*value)	Interpretation
1	1 day/24 hours Blue color	0.014	Not normal	0.035	Not homogen
2	2 days/48 hours Green color	0.761	Normal		
3	3 days/72 hours Orange color	0.245	Normal		
4	4 days/96 hours White color	0.388	Normal		

Table 3. Results of the Kruskall Wallis test on immersion of the solution.

Treatment	Mean ± SD	*p*	Interpretation
24 hours, blue color	0.035 ± 0.034	*0.018	Exist difference
48 hours, green color	0.32 ± 0.22		
72 hours, orange color	0.197 ± 0.176		
96 hours, white color	0.216 ± 0.177		

Table 4. Average Comparison Test between soaking groups of lemon tea solution against surface roughness of nanofiller composite resin (*Mann Whitney*).

Comparison of groups		p-Value	Interpretation
24 hours, blue color	48 hours, green	0.004	There is a difference
	72 hours, orange color	0.026	There is a difference
	96 hours, white color	0.015	There is a difference

Based on data obtained from calculations using the *Mann Whitney test.* It can be concluded that there is an influence on the surface roughness of nanofill composite resins soaked with nestea lemon tea solution between 24-hour and 48.72-hour treatment

Discussion:

The acid consumed will affect the oral cavity, including the restoration of the teeth. One of the restoration materials is composite resin, and one of the ingredients in the composite is polymer, where the polymer contains an unstable bond so that it is easily degraded by acid or low pH. Degradation of polymers and filler components in a restoration material, especially composite resins, will affect the roughness of the restoration surface. The effects of a rough restoration surface can lead to a build-up of dental plaque that will damage the soft tissues as well as their periodontal tissues, aesthetically poorly and clinically becoming more susceptible to damage. [1-6]

Statistical analysis results showed that soaking for 24, 48, 72 and 96 hours had an effect on significant changes in roughness in nanofiller composite resins after immersion in Nestea lemon tea solution. This is in accordance with research conducted by Afrida 2015, which states that there is an effect of soaking tea solution on the surface roughness of nanofiller composite resins because one of the factors is that tea contains acids as well as lemons and limes. There was a significant change in surface roughness in nanofiller composite at 24, 48, 72, and 96-hour soaking.[8] Faustina, et al 2017 stated that the main problem that most often affects material durability is chemical degradation due to exposure to acids, plaque, food, enzymes, ionic composition in saliva which results in softening of the restorative material resulting in a decrease in physical properties and mechanical properties. Viona et al's 2019 study on the effect of changing the roughness of nanofiller composite resin by soaking for 4 days concluded that the acid in coffee also affects the roughness of the composite resin.[8, 9]

Based on research conducted by Sherif et.al in 2020, it is known that the frequency of consumption of coffee, fruit juice, cola and tea greatly affects the roughness of the composite resin, but fruit juice has a greater erosion effect than cola drinks. Alkhadim (2020) stated that tea molecules are believed to be able to penetrate deeper in composite resin materials than coffee molecules. Coffee molecules are found only on the surface of composite resin materials. Surface roughness is also caused by the size of the filler, where the smaller the filler size, the smoother the surface that can be achieved after the polishing process.[10, 11]

Ozkanoglu (2020) stated that the composition and size of filler particles affect the surface roughness of the composite resin and it is possible that nanocomposites with smaller particles will have smoother surface roughness and will produce fewer stains on the surface of the composite resin.[12-14]

Chowdhurry (2021) mentioned surface roughness is associated with the characteristics of restorative materials, material composition, tooth brushing abrasion, low pH beverage foods and oral cleaning content. The effect of low pH or acidity is likely to have a greater impact on the softening of matrix resins and favors the release of filler particles which certainly increases surface roughness. On the other hand, the pH of coffee is close to 7 because coffee contains a lot of water and this water will be absorbed by the resin composite so that the polymer material inside becomes reduced.[15, 16] When polymeric materials absorb water, coupling agents cause hydrolysis and loss of chemical bonds between filler particles and resin matrices. Filler particles are detached from the outermost surface of the material causing surface roughness tea is acidic with a pH of 5, but the polarity of its components is high which will be traced first and will not be readily penetrated inward which may result in a low surface roughness value when compared with coffee and cola drinks.[16]

Vesna et al (2018) observed hydrofluoric acids and stated that acids can make silica and zirconia molecules regardless of nanofiller composite

resins. Nano-composites have good physico-mechanical properties with a high content of filler particles. Nano-composites are less susceptible to prolonged exposure and are more recommended because they have low water resorption. Water resorption is a factor of change in literacy because the bond between filler particles and polymers is hydrolyzed by water media.[17]

Fabiola et al (2012) also explained that acid degradation begins with water absorptions that diffuse internally through matrices, filler surfaces, pores, and defects. Accelerated with low pH conditions and causes the filler matrix to detach or even degrade due to hydrolysis on the surface of the matrix and filler. The incorporation of nanofiller in restorative materials increases the abrasive resistance due to the higher loading of filler with smaller particle size and results in reduced interparticle spacing, which effectively protects the softer matrix, reduces the incidence of filler peeling, and improves the overall resistance of the materials to abrasion. The nano-sized particles that form the nano-clusters are self-detached compared to the entire resin matrix removal. In addition, it can detach from the surface leaving defects even smaller than the wavelength of light thereby still providing satisfactory visual and polishing results.[18]

Based on this study, it can be seen that there is an influence on the surface roughness of nanofiller composite resins soaked with nestea lemon tea solution between 24 hour and 48-72 hour treatments. This is in accordance with Afrida's research which states that soaking the material in a tea solution can also cause surface roughness caused by the acidic nature of the tea.

Faustina et al (2017) stated that other factors that can cause surface roughness include chemical degradation due to exposure to acids, plaque, food, enzymes, ionic composition, and the pH level of the solution in this study was 3.4, which means the solution is a fairly strong acid. This is also in accordance with the research of Viona et al (2019), which conclusive that the acid in coffee affects the surface roughness of composite resins soaked for 4 days. Surface roughness stability was achieved after soaking for more than 48 hours. This is possible because the nanofiller composite has the ability to resist the release of particles from the surface or may be because only a small part of the particles is released. Craig proposed a theory which stated the same thing, that the mechanical strength of nanofiller composites is similar to that of microfill composites but can still maintain smoothness during use, and the release of nano-clusters in nanofiller composites occurs in tandem with the surrounding matrix, so that the surface still looks smooth in the long term. Craig 2018, stated that the water medium can cause inorganic ion leaching so that the interfacial bond is broken. According to research by Fabiola et al (2012) which stated that nanofiller increases abrasion resistance, protects a softer matrix, and reduces filler release. The process of releasing particles that occur on the surface of the composite also occurs in nano-sized particles that are detached from the nanocluster, while nano-sized particles can separate or detach rather than be released as a whole. In accordance with the theory from Phillips (2021) stated that some of the bonds between the nano-sized particles and the nanoclusters are rather loosely bonded, and this sometimes causes roughness. Particle magnitudes above 100nm improve the lack of mechanical resistance possessed by homogeneous nanocomposites, and this will increase the roughness but not overall. Research conducted by Chowdhurry et al (2020) explains the high polarity of tea molecules that must be explored first before penetration of the molecules into the composite resin occurs. However, the water absorption factor also has an effect, considering that the manufacture of Nestea lemon tea involves a lot of water and this is in accordance with the theory of Chowdhurry et al (2021) which explains that a solution with a pH close to 7 can still degrade polymers because it contains a lot of water.[1-9]

Conclusion:

This study concluded that there is an influence on surface roughness in nanofiller composite resins after immersion in nestea lemon tea solution. The peak surface roughness occurred in the nanofiller composite resin group soaked for 48 hours. The influence of the surface roughness of composite resins is likely due to the acidity of the solution, the absorption of the liquid, the timing, the composition of ions, molecular properties of the exposure substance, and mechanical stress.

References:

[1] Anonim. Journal of African Studies and Sustainable Development. Association for the promotion of african studies. 2020;3(11):7-8.

[2] Anshori AM, Wiraguna AAGP, Pangkahila W. Oral Administration of Lemon Peel Extract (Citrus Limon) Inhibits Increased Mmp-1 Expression (Matrix Metaloproteinase-1) And Decreased Collagen Amount In Male Wistar Strain White Rats (Rattus Norvegicus) Exposed To Uv-B Rays. *Journal of E-Biomedicine*. 2017; 5(1).

[3] Goodrich R. Citrus Fruit Lemon. Encyclopedia Of Food Sciences and Nutritions. 2003:1354-1359.

[4] Kaskoos RA. *Journal of Essential OilBearing Plants.* Essential Oil Analysis by GC-MS and Analgesic Activity of Lippia citriodora and Citrus limon. 2019;22(1):273-81

[5] Indriani Y, Mulqie L, Hazar S. Antibacterial Activity Test of Squeezed Water of Lemon Citrus Fruits (Citruslimon (L.) Osbeck) And Forest Honey Against Propionibacterium Acne. *Proceedings of Spesia Unisba Research*. 2015;1(2): 354-361

[6] Elsa A, Hadi S. Effect of Lemon Juice on Surface Roughness of Alkasit Restoration. Conservation Section, Faculty of Dentistry, Trisakti University. *JKGT*. 2019;1(2): 29 – 32.

[7] Tahir KA. Botto-Botto Cream Effect (Chromolaena Odorata L.) Against MMP-1 Expression, TGF BETA-1, And Collagen Histopathology In Photoaging Induced BALB/C Mice Using UVB Rays. [*Dissertation*]. Makassar: FK UNHAS, 2021.

[8] Viodetta R, Susanto C, and Cape DS. Effect of soaking of lemon juice and cikala acid on surface roughness of nanofiller composite resins. *Scientific Journal of Health Sandi Husada*. 2021; 10(1):224.

[9] Diansari V, Sungkar S, And Hardiyanti CR. Surface roughness study of nanofiller composite resin after immersion in gayo arabica coffee brewing. *Journal Of Shia Kuala Dentistry Society*. 2019; 4(2):31.

[10] Sherif R, Wegdan M, Afifi R. Color stability and surface roughness of an organically modified ceramic (ormocer) and a methacrylate based composite resins (An In-Vitro Study). *Alexandria Dental Journal*. 2020;45:100-5.

[11] Alkhadim K, Hulbah J, Nassar M. Color Shift, Color stability, and post-polishing surface roughness of esthetic resin composites. *Materials*. 2020;13:10-3.

[12] Ozkanoglu S. Evaluation of the effect of various beverages on the color stability and microhardness of restorative materials. *Nigerian Journal of Clinical Practice*. 2020:322-7.

[13] Shen C, Rawls R, Esquivel JF. *Phillip's Science of Dental Materials*. 13th Ed. St. Louis, Missouri: Elsevier;2021:89-100.

[14] Sakaguchi R, Ferracane J, Powers J. *Craig's Restorative Dental Materials*. Missouri: Elsevier;2019:137-153.

[15] Mazmumdar P, Chowdhurry D. *The Manual of Laboratory Testing Methods for Dental Restorative Materials*. New Jersey; John Wiley & Sons;2021:20

[16] Chowdhurry D, Mazmumdar P, Desai P, Datta P. Comparative evaluation of surface roughness and color stability of nanohybrid composite resin after periodic exposure to tea, coffee, and Coca-cola : An in vitro profilometric and image analysis study. *J Conserv Dent.* 2020; 23(4):395-401.

[17] Arhun N and Tuncer D. Repair of Direct Resin Composite Restoration. In: Miletic V, editors. Dental Composite Materials for Direct Restorations Belgrade: Springer; 2018. P 250-69

[18] Carvalho FG, Sampaio CS, Fucio SBP, Carlo HL, Correr-Sobrinho L, Puppin-Rontani RM. Repair of Direct Resin Composite Restoration. Platt JA, editor. Operative Dentistry. 2012;37(5):509–17.