# Effect Of Whitening Toothpaste And Toothpowder On Nanofiller Composite Resin Discoloration After Immersion In Black Tea

*Felicia Sucanto*, Taufiq Ariwibowo**, Meiny Faudah Amin****

** Student of Dentistry Education Program, Faculty of Dentistry, Trisakti University*
*** Department of Conservative, Faculty of Dentistry, Trisakti University*
**** Department of Conservative, Faculty of Dentistry, Trisakti University*

**Correspondence:** taufiqariwibowo@gmail.com

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**ABSTRACT**

***Background:*** *One of the factors of discoloration on composite resin is extrinsic factors, such as black tea. Various ways are used to restore the color of composite resin, for example, toothpaste or toothpowder with whitening ingredients. Adding whitening ingredients such as activated charcoal or pearl essence in toothpaste or toothpowder can remove pigments, chromophores, and stains on composite resin with an abrasion effect on the composite surface.*
***Method:*** *This research was an experimental laboratory with a pretest and post-test control group design. This study used 12 samples of nanofiller composite resin (Palfique LX5 B1) in a cylindrical shape with 10 mm diameter and 2 mm thickness. The research was conducted by immersing the samples in black tea for 4 hours with repetition for 13 days. After immersing, the samples were divided into 3 groups: group I was brushed with charcoal toothpaste, group II was brushed with whitening toothpowder, and group III was brushed with non-whitening toothpaste. Brushing was done for 3 minutes with repetition for 13 days. The color parameters were measured using VITA Easyshade V 3 times.*
***Result:*** *The Shapiro-Wilk normality test showed the data normally distributed (p>0,05). The repeated ANOVA test showed no significant color change (p>0,05).*
***Conclusion:*** *Charcoal toothpaste, whitening toothpowder, and non-whitening toothpaste affect the color change of nanofiller composite resin, but there is no significant color change between the three kinds of toothpaste.*



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## BACKGROUND

As time progresses, aesthetics have become one of the important factors for individuals. Aesthetic value in dentistry is needed to combine beauty values with the needs of each patient.[1] Using restorative materials such as composite resin is often chosen as the primary option for conservative and non-invasive treatment. Based on its physical properties, the composite resin also resembles natural teeth, thus fulfilling aesthetic principles.[2]

Composite resin is a tooth-colored restoration that is used to replace damaged or missing tooth structure, correct tooth contours, and enhance tooth aesthetics. Generally, composite resin consists of four main components: dimethacrylate monomer matrix, inorganic filler particles, coupling agent, and initiator-accelerator.[3] The use of composite resin consists of various consistencies, from flowable to packable, which can be used in various cases and will become hard, strong, and solid through polymerization reactions.[4] The success of restorative materials depends on compressive and tensile strength, diametral flexibility, wear resistance, and fracture toughness.[2]

Nanofillers are composite filler particles consisting of a mixture of nanoparticles and nanoclusters. With nano-sized particles, nanofillers have good color stability and translucency. In addition, nanofillers are often used for anterior and posterior tooth direct restorations because they have minimal shrinkage, increase strength, density, and provide a better polished surface.[3,5,6] Composite resin tends to undergo color change when exposed to the oral environment.[2] Color change can be influenced by intrinsic and extrinsic factors. Intrinsic factors are caused by material properties, such as changes in resin matrix, filler resin percentage and size. Meanwhile, extrinsic factors are caused by the absorption of colorants from beverages such as black tea.[7]

Black tea is one of the beverages widely consumed by people in Indonesia and is a type of tea processed through enzymatic oxidation fermentation. Black tea contains coloring substances such as polyphenols, tannins, and phenolic acids that are soluble in water and can be absorbed into restorative materials resulting in color changes.[8] Research by Malekipour et al[9]. showed that black tea significantly causes color changes in composite resin. Besides that, there are several ways to restore the color of composite resin, one of which is by using toothpaste with whitening ingredients.[10]

Activated charcoal is one of the active ingredients in toothpaste with high porosity levels and can remove colorants by absorbing pigments, chromophores, and stains from the tooth surface.[11] Additionally, toothpowder with pearl essence ingredients has abrasive particles that are believed to whiten the tooth surface. Although toothpowder is still rarely used, it remains an option due to concerns about chemicals in conventional toothpaste.[12] This study aims to determine the effect of charcoal toothpaste and whitening toothpowder on the color change of nanofiller composite resin after immersion in black tea for 13 days.

## RESEARCH METHOD

This type of research is a laboratory experimental study with a pretest and post-test control group design, the study was conducted from September to November 2023 at the Dental Material and Testing Center of Research (DMTCore), Faculty of Dentistry, Trisakti University. The research using cylindrical nanofiller composite resin with a diameter of 10 mm and a thickness of 2

mm (ISO 4049(2000)). The sampling technique used a simple random sampling method, where each sample had an equal chance of being selected. The calculation of the number of research samples used the Lemeshow and Lwanga formula. The number of samples in each group was 4 samples. This study consisted of 3 groups: group 1 was brushed using activated charcoal toothpaste, group 2 was brushed using whitening toothpowder, and group 3 (control) was brushed using non-whitening toothpaste. The total number of samples used was 12 samples.

Samples were made using stainless steel mold with the entire mold surface coated with Vaseline to facilitate the removal of composite resin from the mold. Using a plastic filling instrument, composite resin was inserted into the mold and flattened using celluloid strips, then a glass plate was placed on top of the mold and pressed with a 200-gram weight. Composite resin was cured for 20 seconds using a light cure with a perpendicular position and a distance of 1 mm from the sample.

Before immersion in black tea, composite resin samples were subjected to initial color measurements using a pre-calibrated spectrophotometer. Color measurements were taken with a white background to ensure clear visibility of the sample color and were taken in the middle of the sample with a perpendicular position to the sample surface. The samples were always placed in the same position, then data E, L, C, and H were obtained.

Black tea was made by placing 1 bag of black tea in 200 mL of boiling water at 100°C, then the black tea solution was cooled to room temperature. Immersion was carried out for 4 hours per day and continued with immersion in distilled water. Immersion was repeated for 13 days and stored in an incubator at 37°C. The 13-day immersion period is equivalent to consuming black tea for 7 months, assuming each individual consumes black tea for 15 minutes per day.[13]

After 13 days of immersion, the samples were rinsed with water and dried using tissue paper. The color of the samples was measured using a spectrophotometer in the same way as the initial color measurement. After the samples showed a color change, they were brushed according to their sample groups.

Brushing in the sample groups was carried out for 13 days corresponding to the duration of immersion in black tea. Brushing was done using an electric toothbrush with a pressure of 100 grams and a mesiodistal brushing direction. The brushing duration was 3 minutes at the same rotation speed, then the samples were immersed in distilled water and placed in an incubator at 37°C.

After brushing, final color measurements were taken using a spectrophotometer in the same manner as the initial color measurement. The obtained data were subjected to the Shapiro-Wilk normality test to assess the distribution of data in each sample group, whether it was normally distributed or not. If the data was normally distributed, the repeated ANOVA test was conducted, and if the data was not normally distributed, the Friedman test was conducted.

**RESULTS**

The results of color measurement on nanofiller composite resin before immersion in black tea, after immersion in black tea, and after brushing in the sample group can be seen in Table 1 and Figure 1.

**Table 1. Mean value of color change of nanofiller composite resin in the treatment group and control group**

| | Brushing Treatment | Before immersion | After immersion | After brushing |
|---|---|---|---|---|
| | | Mean ± SD | Mean ± SD | Mean ± SD |
| E | Charcoal toothpaste | 8,3 ± 1,2 | 5,2 ± 0,6 | 8,3 ± 0 |
| | Whitening toothpowder | 5,6 ± 0,2 | 8,1 ± 0,6 | 8,4 ± 0,9 |
| | Non-whitening toothpaste | 7,9 ± 0,7 | 5,9 ± 0,3 | 6,9 ± 0,3 |
| L | Charcoal toothpaste | 5,0 ± 1,5 | 5,2 ± 0,5 | 5,2 ± 1,1 |
| | Whitening toothpowder | 5,2 ± 0,4 | 7,3 ± 0,1 | 7,4 ± 0,6 |
| | Non-whitening toothpaste | 4,9 ± 0,6 | 5,1 ± 0,8 | 6,1 ± 2,0 |
| C | Charcoal toothpaste | 6,4 ± 0,4 | 1,2 ± 0,4 | 6,2 ± 0,5 |
| | Whitening toothpowder | 1,9 ± 1,1 | 4,9 ± 0,7 | 4,5 ± 0 |
| | Non-whitening toothpaste | 6,0 ± 0,4 | 3,0 ± 1,6 | 3,0 ± 1,2 |
| H | Charcoal toothpaste | 3,8 ± 0,3 | 1,9 ± 1,3 | 4,5 ± 0,3 |
| | Whitening toothpowder | 0,7 ± 0,1 | 1,6 ± 1,3 | 2,0 ± 1,1 |
| | Non-whitening toothpaste | 4,7 ± 0,3 | 0,5 ± 0,3 | 0,6 ± 0,4 |

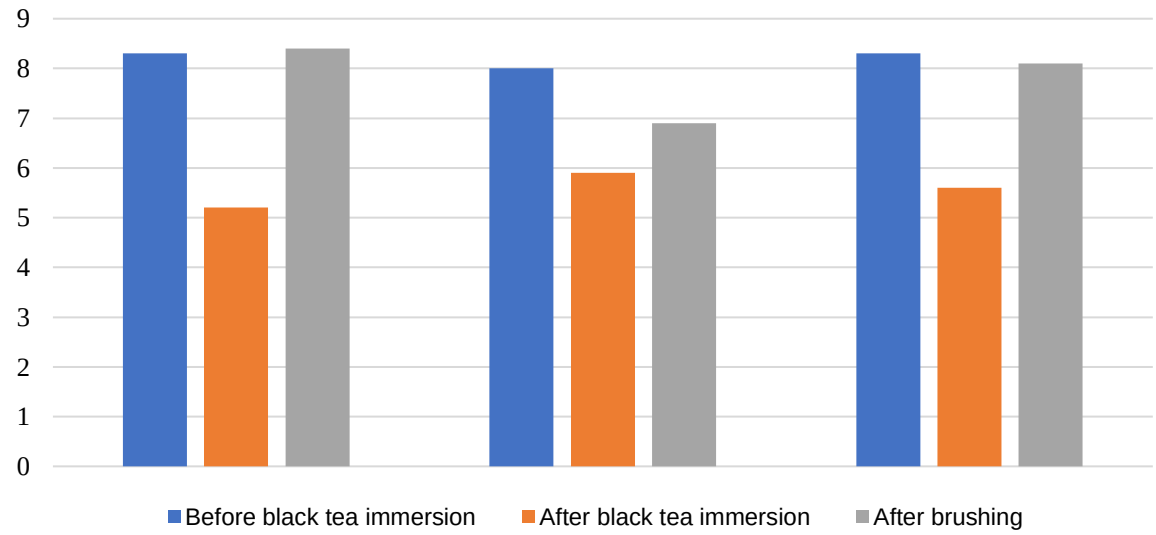


**Figure 1.** Comparison of mean ΔE values in the three sample groups

Table 1 shows the results of color measurements in the treatment group and control group regarding the color change of nanofiller composite resin. After immersing the samples in black tea, the mean values of E, C, and H decreased compared to before immersion in black tea, while the mean value of L increased. After brushing according to the sample groups, the mean values of E, L, C, and H increased compared to after immersion in black tea.

The results of the Shapiro-Wilk normality test in all sample groups showed the data are normally distributed with significance values greater than 0.05, thus continuing with the repeated ANOVA parametric test. The results of the repeated ANOVA test yielded findings as shown in Table 2, indicating the differences in color change of

nanofiller composite resin after brushing using charcoal toothpaste, whitening toothpowder, and non-whitening toothpaste.

**Table 2. Repeated ANOVA test results on charcoal toothpaste, whitening toothpowder, and non-whitening toothpaste**

| Groups | Mean ± SD | *P value* |
|---|---|---|
| Charcoal toothpaste | 8,42 ± 0,96 | 0,054 |
| Whitening toothpowder | 6,97 ± 0,37 | |
| Non-whitening toothpaste | 8,17 ± 0,60 | |

***p>0,05 no significant difference**

The Repeated ANOVA test results show a significance value on ΔE (0.054), ΔL (0.335), and ΔH (0.312), indicating no significant color change (p>0.05). However, the significance value on ΔC (0.037), indicating a significant color change (p<0.05)

## DISCUSSION

Color changes in composite resin can be influenced by intrinsic and extrinsic factors. Extrinsic factors are caused by smoking habits, poor oral hygiene, and consumption habits of foods and beverages containing color pigments. Meanwhile, intrinsic factors are influenced by the composition of the resin matrix and fillers.[7] With the hydrophilic properties of the resin matrix, the level of water absorption into the composite material increases. Water absorption in composite resin can reduce the lifespan of the restoration by causing the matrix to swell and become plastic, then hydrolyzing the silane coupling agent and resulting in the formation of gaps. These gaps between the resin matrix and filler allow color pigments from black tea to penetrate and cause color changes in the composite resin.[9,14]

Color changes can also be influenced by the pH contained in black tea. According to Karin et al.,[15] low pH values of a solution can result in damage to the resin matrix and an increase in water and color pigment absorption. Additionally, compounds such as tannins and thearubigins contained in black tea can cause significant color changes in composite resin. Based on previous research by Malekipour et al.[9] color changes in composite resin caused by black tea can be removed by brushing.

Based on the brushing results using charcoal toothpaste, whitening toothpowder, and non-whitening toothpaste, there was an increase in the mean E value (Table 1). The E value indicates color changes on the sample surface that can be observed by the human eye. Based on the color changes on the restoration, there are three different intervals used to differentiate the color change values: if ΔE < 1, then the color change cannot be observed by the human eye; if 1.0 < ΔE < 3.3, then the color change can be seen by a skilled operator and clinically acceptable; and if ΔE > 3.3, then the color change can be observed by the human eye but is not clinically acceptable.[14] Brushing on the samples was performed using an electric toothbrush with soft bristles because it has better

flexibility, allowing for greater contact between the bristles and the sample surface.[16]

After it was found that charcoal toothpaste, whitening toothpowder, and non-whitening toothpaste can affect the color change of nanofiller composite resin, a parametric test was conducted to determine which toothpaste is more effective in enhancing brightness in the samples. The statistical test results showed that there was no significant color change between the three types of toothpaste (Table 2). In other words, charcoal toothpaste, whitening toothpowder, and non-whitening toothpaste have the same effectiveness in changing the color of nanofiller composite resin.

Activated charcoal contained in toothpaste has a porous structure with high absorption capabilities, so stains and color pigments are attracted to and trapped by its porous shape. The cleaning effect of charcoal toothpaste occurs due to mild abrasive forces acting on the surface of the restoration.[17,18] This aligns with previous research by Pertiwi,[19] the charcoal toothpaste has larger abrasive particle sizes, resulting in mechanical cleaning effects. Additionally, activated charcoal toothpaste containing hydrated silica has effective tissue strength in removing color pigments from composite resin. Hydrated silica works by enhancing physical cleaning strength with the same pressure while brushing teeth.[20] This is further supported by the study conducted by Raneem et al.,[21] demonstrating the excellent effectiveness of activated charcoal in removing stains from composite resin.

The whitening toothpowder used in this study contains pearl essence, which is believed to whiten the surface of teeth. Similar to charcoal toothpaste, whitening toothpowder also contains abrasive particles that work mechanically to remove stains on the surface of composite resin.[22] Research by Gulben et al.,[23] stated that whitening toothpowder has a low level of effectiveness in whitening and brightening composite resin. One of the factors is its high level of abrasiveness, causing coarse particles to scratch the surface and reduce brightness on the composite resin surface.[22]

Based on research by Kadhim et al.,[24] stated that toothpaste containing silica has a low level of abrasiveness, but the addition of calcium carbonate to toothpaste increases the level of abrasiveness. One of the compositions found in non-whitening toothpaste in this study contains calcium carbonate, so non-whitening toothpaste does not provide better whitening effects than charcoal toothpaste.

The results of this study show the whitening effect of charcoal toothpaste and whitening toothpowder on the color change of nanofiller composite resin. There are several limitations to this study, such as the research conducted only assesses color changes so that with research on surface roughness, the effect of brushing toothpaste containing abrasive particles on the surface roughness of the sample can be known. In addition, research on whitening toothpowder is still rarely done, leading to a lack of literature on this material.

## CONCLUSION

Based on the results of this study, it can be concluded that brushing with charcoal toothpaste and whitening toothpowder affects the color change in nanofiller composite resin. However, the color change in the E, L, and H values did not show significant results, while the C value showed significant differences between the treatment groups and the control group.

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## REFERENCES


1. Manipal S, Mohan CSA, Kumar DL, Cholan PK, Ahmed A, Adusumili P. The Importance of Dental Aesthetics Among Dental Students Assessment of Knowledge. J Int Soc Prev Community Dent. 2014;4(1):48-51. https://doi.org/10.4103/2231-0762.131266
2. Fontes ST, Fernandez MR, de Moura CM, Meireles SS. Color Stability of A Nanofill Composite: Effect of different immersion media. J Appl Oral Sci. 2019;17(5):388-91. https://doi.org/10.1590/S1678-77572009000500007
3. Sakaguchi R, Ferracane J, Powers J. Craig's Restorative Dental Materials, Fourteenth Edition. St. Louis, Missouri: Elsevier Inc; 2019:135–156
4. Anusavice KJ, Shen C, Rawls HR. Phillips´Science of Dental Materials. 12th ed. 2013;34(28):275-290.
5. Napitupulu IMB, Hutagalung MHP. Perbandingan Perubahan Warna Resin Komposit Nanofiller dan Nanohybrid Setelah Perendaman Pada Susu Fermentasi. Jurnal Kedokteran Gigi. 2020;17(1):29-32. https://doi.org/10.19184/stoma.v17i1.23610
6. Virgiani YS, Soetojo A, Zubaidah N. Discoloration of Nanohybrid and Nanofiller Resin Composite after Exposure to Turmeric. Conservative Dentistry Journal. 2021;11(1):46-49. https://doi.org/10.20473/cdj.v11i1.2021.46-49
7. Qaraghuli AM, Signore A, Benedicenti S, El Halawani MT, Solimei L. Comparison and Effect of Common Beverages on Color Stability of Different Esthetic Restorative Materials: An In Vitro Study. J Contemp Dent Pract. 2022; 23(11):1085–90. https://doi.org/10.5005/jp-journals-10024-3419
8. Firdaus DA. Perbedaan Perubahan Warna Resin Komposit Nanofiller dan Nanohybrid Terhadap Perendaman Teh Hitam (*Camellia sinensis*) [Skripsi]. Malang: Fakultas Kedokteran Gigi Universitas Brawijaya; 2018. p.1-3.
9. Malekipour MR, Sharafi A, Kazemi S, Khazaei S, Shirani F. Comparison of color stability of a composite resin in different color media. Dent Res J (Isfahan). 2012;9(4):441–446.
10. Bayahu C, Pengemanan DHC, Mintjelungan CN. Uji Efektivitas Pasta Gigi Pemutih terhadap Perubahan Warna Gigi Ekstrinsik. Jurnal Ilmiah Kedokteran Gigi. 2021;9(2):204-205. https://doi.org/10.35790/eg.v9i2.34872
11. Ghajari MF, Shamsaei M, Basandeh K, Galouyak MS. Abrasiveness and Whitening Effect of Charcoal-containing Toothpastes in Permanent Teeth. Dent Res J (Isfahan); 2021.
12. Kareem A, Khan M, Khan A, et al. Does the use of toothpowder affect the oral health status of an individual. JPDA. 2012;21(3):153.
13. Cobanoglu N, Sag Gungor F, Abdulateef OF, Velioglu MS, Simsek Balabab EC. Effect of Translucency on Color Stability of Resin-based Composites. Bezmialem Sci. 2023;11(2):213–20. https://doi.org/10.14235/bas.galenos.2022.86719
14. De Alencar e Silva Leite ML, Da Cunha Medeiros e Silva FDS, Meireles SS, Duarte RM, Maciel Andrade AK. The Effect of Drinks on Color Stability and Surface Roughness of Nanocomposites. Eur J Dent. 2014;8(3):330–336. https://doi.org/10.4103/1305-7456.137640
15. Fitria KT, Riyadi S. The Effect of Composite Brushing with Different Types of Toothpaste on Stain Due to Immersion in Coffee, Tea, and Cuko Pempek Water. J Kesehat Gigi. 2019;6(2):13. https://doi.org/10.31983/JKG.V9I1.7998
16. Kumar S, Singh SK, Gupta A, Roy S, Sareen M, Khajuria S. A Profilometric Study to Assess the Role of Toothbrush and Toothpaste in Abrasion Process. 2015. p.16.
17. Lempang M. Pembuatan dan Kegunaan Arang Aktif. Info Teknis EBONI. 2014;11(2):65-80.
18. Widjayanti H. Efektivitas Pasta Gigi yang Mengandung Charcoal Dengan Pasta Gigi yang Tidak Mengandung Charcoal Terhadap Skor Debris Indeks [Skripsi]. Semarang: Politeknik Kesehatan Semarang; 2021. p.14-15.
19. Pertiwi UI, Eriwati YK, Irawan B. Surface changes of enamel after brushing with charcoal toothpaste. J Phys Conf Ser. 2017;884(1):2-3. https://doi.org/10.1088/1742-6596/884/1/012002
20. Cho MJ. The tooth whitening effect of toothpaste containing high cleaning silica and sodium hexametaphosphate and the preventive effect of staining by coffee, tea and wine. Int J Clin Prev Dent. 2020;16(4):192-9. https://doi.org/10.15236/ijcpd.2020.16.4.192
21. Alofi RS, Alsuayri HA, Mohey LS, Alofi AS. Efficiency of Activated Charcoal Powder in Stain Removal and Effect on Surface Roughness Compared to Whitening Toothpaste in Resin Composite: In Vitro Study. Saudi Dent J. 2021;33(8):1105-1110. https://doi.org/10.1016/j.sdentj.2021.03.010
22. DM Hemalatha, Chandran N, MR Arjun, MK Geethu, S Gokulavardhini. Dentifrice-Fricare

your Teeth. J Dent Sci Res Rep. 2022;4(4):2-4. https://doi.org/10.47363/JDSR/2022(4)142
23. Colak G, Katirci G. In Vitro Evaluation of the Effect of Whitening Toothpastes on the Color and Surface Roughness of Different Composite Resin Materials. 2023;23(1):1-12. https://doi.org/10.1186/s12903-023-03277-4
24. Kadhim AJ, Shalan LA. Effect of Dentifrices With Different Abrasives on the Surface Roughness of A Nano Composite Resins Materials. Indian J Forensic Med Toxicol. 2021;15(1):744–52. https://doi.org/10.37506/IJFMT.V15I1.13506