



THE EFFECT OF ESPRESSO AND DRIP BREWING COFFEE METHODE TO THE HARDNESS OF BULK-FILL COMPOSITE RESIN

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ABSTRACT

Background: The most restoration material used currently in dentistry was composite resin. The newest generation of composite resin was bulk-fill composite resin. The bulk-fill composite resin had advantages of lower polymerization contraction and a more straightforward and faster restoration technique. One of the factors which could affect the hardness of composite resin was the consumption of acidic drinks. The acidic beverage that people often consumed is coffee. A few coffee brewing methods were espresso and drip brewing. **Objective:** This research aimed to identify the effects of coffee soaking through espresso and drip brewing methods on bulk-fill composite resin's hardness. **Methods:** his research was experimental research, with a post-test control group design and a total sample of 27 samples. The soaking process was taken for seven days at a temperature of 37°C on artificial saliva, espresso, and drip brewing coffee methods. The hardness of bulk-fill composite resin was measured after seven days by using Vickers hardness. The statistic test exerted One-Way ANOVA. **Results:** This research found a significant difference in bulk-fill composite resin's hardness among all groups, p-value = 0.00 ($p < 0.05$). The result of the post-hoc LSD test showed a significant difference in the change of bulk-fill composite resin hardness between the artificial saliva group and espresso group ($p = 0.00$) and no significant difference found between the artificial saliva group and drip brewing group ($p = 0.85$). **Conclusion:** Soaking with espresso coffee has the smallest hardness value compared to soaking with drip brewing coffee and artificial saliva, so soaking with espresso coffee is the most influential on the hardness of the bulk fill composite resin.

Keywords: Composite Resin, Bulk Fill, Hardness, Espresso, Drip Brewing

INTRODUCTION

The most frequently used restorative material in dentistry is composite resin. Composite resin's physical and optical properties are closely similar to the natural teeth, which makes the composite resin material much preferred nowadays. The newest generation of composite resin is bulk-fill composite resin. Different chemical composition is found on bulk-fill composite resin, for example, ivocerin, monomer modification, and initiator system. The difference in this chemical composition is aimed to obtain the result of lower polymerization contraction.^{1,2}

The bulk-fill composite resin has the advantages of lower polymerization contraction and a more straightforward and faster restoration technique. The most significant advantage of bulk-fill composite resin material is that it can be applied into the cavity with a thickness of 4 mm. The high translucence on bulk-fill composite resin helps the particle penetrate deeper, so the bulk-fill composite resin can be put into a depth of 4 mm. The bulk-fill composite resin is a type of Nanohybrid composite resin.^{1,3}

The composite resin has the physical feature of hardness. The factor which can influence the hardness is the consumption of acidic drinks, for instance, coffee. The data from International Coffee Organization (ICO) has recorded that the average growth of coffee consumption in Indonesia is higher than in general. The coffee drink served has many variations, from the coffee type used and coffee brewing method to make the favorable coffee drink. There are a few coffee brewing methods: espresso and drip brewing.⁵

The espresso brewing method is a method of coffee brewing by using an espresso machine, which uses the press to result in a coffee solution. It differs from the drip brewing method, which uses a filter in coffee brewing to result in a coffee solution.⁵ The selection of brewing method affects the process of coffee bean extraction. The duration of brewing also takes a significant role in the coffee antioxidant extraction.³⁴

If the composite resin material gets contacted with phenol compounds, it will show a chemical change that can harm the composite resin surface. This condition occurs since the compounds will get



into the resin surface and cause the surface to expand and soften. Regarding the compounds inside the coffee, the coffee can cause a reduction of hardness level on the composite resin.⁷ The explanation above explains that various brewing methods will result in coffee solutions with different compound contents. Therefore, this condition attracts the researchers to do further research and take this matter as the research background.

MATERIALS AND METHODS

This research was a laboratory experimental research which exerted pots-test only control group design. The sample was bulk fill composite resin which has been impressed with diameter of 10 mm and thickness of 4 mm, at the smooth and flat composite resin surface. In this research, the researchers used 27 samples of bulk fill composite resin which was divided into three treatment groups, the treatment of soaking in espresso coffee solution, soaking in drip brewing coffee, and soaking in artificial saliva. The method of espresso coffee making was started with coffee bean milled by using grinder with fine grind level and after that, the coffee powder would put into porta and continue to tempting process or coffee grounds compaction within the porta, so it was continued to brewing process by using espresso machine for 25-30 seconds. While, the coffee making would use drip brewing method, which the coffee was milled in medium level, next was water heating in a kettle until a temperature level of 90°, so put the coffee powder in the dripper, and pour the water into the dripper. Those three groups were soaked for 7 days with a temperature of 37°, the solution should be replaced every day in order to confirm that the solution was in a good condition and less acidic. After the soaking for 7 days, the three groups continued to the hardness test by using Vickers hardness tool wit VHN (Vickers Hardness Number) unit at Integrated Laboratory of Diponegoro University.

This research employed normality test of Saphiro Wilk, since the sample size were <50 subjects. The homogeneity test in this research used lavene's test which was aimed to find the data variance. The collected data had a normal and homogeneous distribution, thus, it was continued to parametric test of One-Way Anova in order to analyze the differences among the groups of research, the last, it was continued to the post-hoc LSC test.

RESULTS

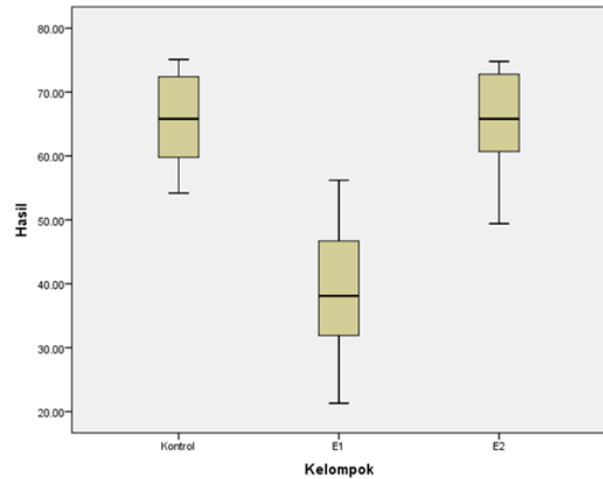


Figure 1. Hardness Average of Bulk Fill Composite Resin Surface on Each Soaking Group

The result of statistic data analysis showed mean value, standard deviation, Anova test result could be seen on the following table 1.

Table 1. A Descriptive Analysis on the Hardness of Bulk Fill Composite Resin (VHN)

Coffee Brewing Method	n	Mean ± SD	Probability (p)
Artificial Saliva (ml)	9	65.51 ± 2.69	.000*
Espresso Coffee (ml)	9	39.66 ± 3.84	
Drip Brewing Coffee (ml)	9	64.66 ± 3.02	

*One-Way Anova, $p < 0.05$

The research data was distributed normally and homogeneously, therefore it could continue to the One-Way Anova test. One-Way Anova test was conducted and aimed to identify the difference of bulk fill composite resin hardness for artificial saliva, espresso coffee, and drip brewing coffee soaking. The result of Anova test showed that $p = 0,00$ ($p < 0,05$), which it was referred a significant difference of bulk fill composite resin among the three groups of coffee brewing method.

The descriptive analysis result referred that the fewer value of bulk fill composite resin's hardness was on the group of espresso coffee soaking, approximately 39.66 ± 3.84 VHN, while the greatest value of bulk fill composite resin's hardness was on the group of artificial saliva soaking, approximately 65.51 ± 2.69 VHN. On the table 4, it showed that the



group of artificial saliva, espresso coffee, and drip brewing coffee treatment have resulted significant values, the p value was higher than 0.05, it meant that all treatment groups were normally distributed. The homogeneity value of mean data on the surface hardness of bulk fill composite resin was 0.55 ($p < 0.05$), thus, the data was homogenous.

The statistic test was continued by exerting post hoc LSD test. The result of post hoc LSD test showed a significant difference on the hardness change of bulk fill composite resin between artificial saliva group and espresso group ($p < 0.05$). But, no significant difference was found between artificial saliva group and drip brewing group ($p > 0.05$).

Table 2. Result of Post Hoc LSD Test

Coffee Brewing Method	Artificial Saliva	Espresso Coffee	Drip Brewing Coffee
Artificial Saliva	-	0.00*	0.85
Espresso Coffee	0.00*	-	0.00*
Drip Brewing Coffee	0.85	0.00*	-

* $p < 0.05$

DISCUSSION

The type of drink which contained a low pH level could reduce the hardness of bulk fill composite resin. This research showed that the acid content from espresso coffee brewing method was able to affect the hardness of bulk fill composite resin. The result of Anova test indicated that $p = 0.00$ ($p < 0.05$), this value referred a significant difference of bulk fill composite resin hardness on all soaking groups. This result was in line with the research hypothesis which has asserted a difference of bulk fill composite resin's hardness which soaked into the coffee solution by using both espresso and drip brewing methods.

A significant difference was also found between the groups of espresso coffee soaking and artificial saliva soaking, because the espresso coffee had more mineral content than coffee in the other brewing methods. The group of artificial saliva and drip brewing coffee soaking did not show a significant difference.⁸ The difference of brewing method would affect the different fineness level of coffee grinder, the espresso method used coffee bean with the very fine fineness level, while drip brewing coffee used medium or less fine fineness level. The ratio of

espresso method was 1:2, which it was referred to the use of 1 gram of coffee and 2 ml or water, while on the drip brewing method, the ratio of coffee and water was 1:13, which it was referred to the use of 1 gram of coffee and 13 ml or water. The less amount of water would result the thicker and concentrated coffee brew.²³ The fineness level of coffee bean grinder could also affect the coffee taste, the fewer size of coffee powder and the wider coffee surface, so the coffee would be more extracted maximally. Moreover, the maximum extraction process could result the coffee solution in thicker color, flavor, and taste.³¹

Antioxidant was one of compound contents within the coffee. A preliminary research has stated that the grape seed and pine bark extract solution have antioxidant which could increase the bonding strength of composite which has been decreased after bleaching treatment.³³ Hence, the antioxidant content within the coffee was able to affect the hardness of composite resin.

The choice of brewing method affected to the process of antioxidant extraction. The longer brewing process, the antioxidant could be extracted. This condition was because the longer process of brewing would make the water and coffee powder to have a longer contact, so it could extract another compound as antioxidant. The drip brewing method could spend brewing process about 2.5-3 minutes, while the espresso method could spend about 30 seconds, the longer process of drip brewing would determine the more antioxidant in the coffee through the drip brewing method.³⁴

This research was in line with the research done by Nurmalasari which has asserted in her research that the composite resin which has been soaked into the coffee and black tea resulted the increased roughness on composite resin which has been soaked into the coffee. Inasmuch as, the coffee has lower pH level than the black tea. The roughness of composite resin was because the matrix material has been eroded due to the degradation that would leave filler lumps.⁶ Another research done by Kumari et al has said that the exposure of acidic content could affect the dental restoration, because the various pH level would cause erosion to the restorative material by releasing the matrix-forming substances. Further, the effect of chemical degradation could cause the change of micro hardness and surface roughness.²⁶



The chlorogenic acid content ($C_{16}H_{18}O_9$) in robusta coffee was about 7.0-10.0%. When the chlorogenic acid has been in contact with the composite resin, the composite resin would indicate the weight increase and chemical change which were able to harm the surface of composite resin. Next, the phenol propanoic would get into the resin surface and cause the surface to expand and soften. This condition was triggered by the composite resin nature which could absorb the water slowly in certain period of time in the absorption mechanism through water molecules diffusion. Furthermore, the chlorogenic acid was a polyphenol compound which has a chemical molecular structure with many H^+ ions. The H^+ ion contained in chlorogenic acid which was found in the coffee caused the chemical bonds of composite resin matrix polymer double chain to become unstable. This instability then caused the break of matrix polymer double chain, the breaking polymer chain could cause the matrix material to erode and affect the hardness of composite resin.^{29,30}

CONCLUSION

This research found the effects on hardness of soaked bulk fill composite resin through espresso coffee brewing method.

Ethical Approval

There is no ethical approval.

Conflicts of Interest

The authors declare no conflict of interest.

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Author Contributions

Authorship must be limited to those who have contributed substantially to the work reported.

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