



## Effect of Pempek Vinegar on Composite Resin Hardness Nanohybrid

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### ABSTRACT

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**Background:** Nanohybrid composite resin is a dental restorative material that is widely used in modern dental practice. However, the interaction of these materials with acidic foods and drinks, such as pempek vinegar, can affect their mechanical properties.

**Materials and Methods:** This research is laboratory experimental research with pretest-posttest with only group design. In this study, nanohybrid composite resin was used in the form of a circle on a mold with a thickness of 2 mm and a diameter of 10 mm which was immersed in a solution of pempek vinegar. The number of samples used is 6 samples with 4 test groups. The 4 test groups were divided into immersion times of 1,3,5,7 days.

**Results:** After immersion, the results of the hardness of the composite resin were taken. Using the normality and homogeneity tests, the hardness test results data were processed. It was found that the data were normally distributed and not homogeneous for each data group. After that an analysis was carried out using independent t-test ( $p < 0.005$ ) it was found that there was a significant effect of the hardness of the composite resin on immersion in Pempek vinegar solution which was soaked for 3 days, 5 days and 7 days.

**Conclusion:** Pempek vinegar solution affects the surface hardness of the nanohybrid composite resin which is probably influenced by pH, liquid absorption ability, and soaking time.

### KEYWORDS:

Hardness, Nanohybrid Composite Resin, Pempek vinegar.

### INTRODUCTION

Appearance is something that is very concerning to most people who live in today's modern era. One of the various ways that can be done to maintain appearance is to repair teeth that have experienced caries or cavities by filling the carious teeth. Filling cavities is not only for aesthetic purposes, but can be used to improve tooth function, especially chewing, and to prevent invasion of pathogenic bacteria which will cause continued infection in the tooth. Materials commonly used in dentistry as

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filling materials include amalgam, *Glass Ionomer Cement (GIC)*, and composite resins. Each of these materials has advantages and disadvantages, both in terms of aesthetics, the ability to withstand pressure and how to manipulate materials. Composite resin is most often used because composite resin has the same color as natural teeth so it has good esthetic value.<sup>1</sup>

One type of composite resin that is often used is composite resin nanohybrid. Composite resin nanohybrid which is commonly known as small particle composite which makes this composite easy to polish with a smoother surface than composites with larger particles. Disadvantages of composite resin nanohybrid is the degradation of the composite resin matrix polymer network and the release of unreacted composite resin components, due to exposure to beverages with an acidic pH. The process of degradation of the composite resin matrix can change

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the microstructure of the composite by forming pores in the composite resin, so that a number of residual monomers come out of the pores. There are several factors that affect the hardness of composite resins including physical properties such as solubility and water absorption. Chemical properties such as hardness are affected by polymerization including the thickness and duration of irradiation. Other factors that affect the hardness of the composite are the food and drink consumed.<sup>1</sup>

The hardness of the composite resin using light curing is influenced by various factors, such as water absorption and solubility. This hardness can also be affected by the polymerization process, including the irradiation distance, the thickness of the material, the duration of irradiation and the food or drink consumed by the patient. Water absorption in the composite resin can come from the food or drink consumed by the patient on a daily basis which is in direct contact with the surface. Tooth surface hardness changes in composite resin immersed in several acidic solutions.<sup>2</sup>

Resin composites often suffer damage in the oral cavity in the form of abrasion (brushing), attrition (diet and parafunctional habits) and erosion (citrus drinks, fruit, soft drinks). The erosive activity of the beverage affects the composite restoration, causes the surface to become rough which affects the optical properties of the material, and facilitates bacterial plaque buildup and surface degradation of the restoration. Erosion causes a decrease in hardness and resistance. In addition, surface roughness can cause gingival irritation and increase the risk of secondary caries. Thus, the surface characteristics of the resin composite contribute to the clinical durability of the restoration.<sup>3</sup> The acid content can also cause discoloration of the composite resin. This can happen because the acid content can cause roughness and microleakage, so that the dyes in the food are absorbed by the surface of the composite resin and cause discoloration. One of the foods that contain acid is pempek vinegar.<sup>4</sup>

Pempek vinegar is a liquid sauce or sauce that accompanies pempek, a culinary specialty of South Sumatra, especially Palembang, which tastes sour, sweet and spicy with the taste and aroma of spices (spice) which is distinctive and pungent, is obtained from a mixture of sugar, chili, vinegar, garlic and salt with a certain composition. The specific characteristics of pempek vinegar, especially its vinegar, have tooth-damaging properties (caries dental) proposed by Hoppenbrouwers and Driessens (1988) they simulated tooth decay artificially (artificial caries dental) found that acetic acid damages teeth twice as strong as lactic acid.<sup>5</sup>

### MATERIALS AND METHODS

This type of research is in the form of laboratory experimental research pre-test and post-test with only group design using a composite resin sample nanohybrid circular with

a diameter of 10 mm and a thickness of 2 mm. There were 24 samples which were divided into 4 groups with each group consisting of 6 samples. The division of sample groups was carried out based on variations in soaking time in pempek vinegar solution, namely for 1 day, 3 days 5 days and 7 days. After immersion, the samples were measured using Vicker hardness reverse.

Prior to immersion, the nanohybrid composite resin samples that had been made were subjected to a hardness test at the Tarumanagara University Technical Laboratory in May 2023 to see the hardness before being immersed in the pempek vinegar solution.

### RESULTS

Hardness testing was carried out using a sample in the form of a composite resin nanohybrid with the measuring instrument used *Vicker hardness reverse*. The test results are shown in table 1.

Based on the results in table 1, it was found that the content in the pempek vinegar solution used in the study had a pH of 4.01. The results of measuring the average hardness value of composite resin nanohybrid before and after soaking the samples for 1 day, 3 days, 5 days and 7 days was 85.7 can be seen in table 2.

The sample was subjected to a T test after it was found that the data were normally distributed and homogeneous. The results of calculations using the paired t test obtained all color values light, chrome, and hue  $p < 0.05$ , then it can be concluded that there was a significant difference in discoloration of the first and second permanent incisors both maxillary and mandibular before and after immersion in tomato juice.

**Table 1. Average sample results**

Time	Rerata	Surface Hardness Average Value
1 Day	Before soaking	85.7
	After soaking	85.14
3 Days	Before soaking	85.7
	After soaking	78.98
5 Days	Before soaking	85.7
	After soaking	74.55
7 Days	Before soaking	85.7
	After soaking	70.12

### DISCUSSION

This research was conducted to determine the differences in the surface hardness of composite resin nanohybrid before and after soaking in Pempek vinegar solution on 24

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samples with a rectangular shape measuring 10 mm in diameter and 2 mm in thickness. This research is a composite resin nanohybrid for 1 day, 3 days, 5 days, and 7 days using pempek vinegar solution. The pempek vinegar solution used in this study took reference from the research of Siti Rusdiana et al (2020). The pH in this solution is 4.01. Based on the results of research that has been done, the average hardness value of composite resin nanohybrid without treatment is 85.7.

Composite resin is a restorative material that is commonly used in dentistry. One type of filler-based composite resin is composite resin nanohybrid. Consuming acidic beverages for a long time can lower the pH of the mouth, which can cause the liquid to be absorbed into the composite resin.

The type of resin used in this study is composite resin nanohybrid. Composite resin nanohybrid is an innovative material that combines the superior properties of two or more different types of resins, namely type resins nanofiller and type hybrid. The advantage of this resin lies in the nanoparticles which are evenly distributed in the resin matrix, providing better strength and durability compared to conventional resins. In addition, composite resin nanohybrid also offers superior aesthetics with a more natural color, making it suitable for use in dental restoration applications and various other restorative procedures. In this study, composite resin nanohybrid is used as a base material for the development of new products with the aim of improving the quality and durability of materials, as well as increasing patient satisfaction in dental treatment.

Based on the research results of Masayu Nashiyatul Dania (2010) stated that Pempek Vinegar has an effect on increasing the surface roughness of the type of composite resin *hybrid*. This increase in roughness can facilitate plaque retention and reduce the aesthetic value of the composite resin hybrid.

Based on the results of Pinton Disai's research (2011), it can be concluded that the concentration of 1% vinegar solution is a safe concentration limit for consumption because it does not cause excessive damage to the enamel and 10 minutes of immersion time is a safe soaking time limit for consumption because it does not cause excessive damage to email. <sup>6</sup>

The results of this study were reinforced by the results of Nabila et al research (2019), that there was a change in the surface color of the composite resin nanohybrid after soaking in pempek vinegar. This color change is caused by intrinsic and extrinsic factors. The intrinsic factor that causes the color change is from the matrix and filler the composite resin itself, while the extrinsic factors that cause discoloration are citric acid and brown sugar contained in pempek vinegar. <sup>4</sup>

The results of this study are in line with the research of Siti Rusdiana Puspa Dewi et al (2020), stating that various kinds of pempek vinegar can reduce the hardness of enamel. This decrease in enamel hardness can occur because the pH of pempek vinegar is acidic, in this study it was also stated that adding ebi

could reduce the decrease in enamel surface hardness in pempek vinegar. <sup>7</sup>

This is in accordance with the theory according to Craig et al. (2022), stated that according to Craig et al. (2022), the hygroscopic expansion process associated with taking liquid can reduce the polymerization stress but the absorption of liquid in the composite resin will be slow, with a measurement time of hygroscopic expansion starting 15 minutes after the initial polymerization, most composite resins need 7 days to reach equilibrium. Composite resin that is not sufficiently polymerized will have greater water absorption and solubility thereby affecting the properties of the composite resin including hardness properties. <sup>27</sup>

According to Craig's theory, *et al.* (2022), stated that the factors that affect the hardness of the composite resin nanohybrid surface smoothness and wear is often determined by the particle size of the filler, resin surface composite nanohybrid may become dull gradually after some time. This may be due to the hydrolysis process through acid or base catalytic reactions. Hydrolysis process that occurs in composite resin nanohybrid can cause the release of the -OH group and enter the filler surface and affect the surface of the composite resin including hardness. Liquid absorption in composite resin nanohybrid lower than other types of composite resin. <sup>8</sup>

Based on the research that has been done, the hardness of the composite resin nanohybrid soaked in pempek vinegar solution was effective for 1 day, 3 days, 5 days and 7 days. The decrease in the surface hardness of the composite resin was caused by the long soaking time in pempek vinegar with a very low pH, the content of tartaric acid in tamarind, surface degradation, liquid absorption, and surface smoothness. The longer the composite resin is in contact with the acid solution, the lower the surface hardness of the composite resin.

**Table 1. Average sample results**

Time	Mean ± Standard Deviation	Say.(2-tailed)	Data Interpretation
1 Day	85.1400 ± .31299	*.226	There is no difference yet
3 Days	78.9867 ± .23149	*0.000	There is a difference
5 Days	74.5550 ± .16368	*0.000	There are differences
7 Days	70.1283 ± .29444	*0.000	There are differences

\*Independent T Test:  $p < 0.0005$ : significant

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### CONCLUSION

Based on the results of research that has been done regarding the effect of immersing pempek vinegar solution on the surface hardness of the resin nanohybrid it can be concluded that tamarind solution affects the hardness of composite resin nanohybrid then the change in hardness of the composite resin nanohybrid caused by acid, surface degradation pH, liquid absorption, surface smoothness condition and soaking time.

### SUGGESTION

After conducting this research, the researchers hoped for a number of things. It is necessary to carry out further research with different concentrations of pempek vinegar to find out how the level of hardness occurs after immersion and it is necessary to carry out further research with different soaking periods to find out how the level of violence occurs after immersion.

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