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THE EFFECT OF THE ACIDITY OF FERMENTED MILK AGAINST THE HARDNESS OF NANOHYBRID COMPOSITE RESIN

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ABSTRACT

Background : The hardness of nanohybrid composite resin can decrease due to the acidic condition of the oral cavity. The acidic condition of the oral cavity can cause continuous degradation in composite resin. Fermented milk is a beverage that is widely sold in the market and is good for consumption however this beverage has the acid potential of hydrogen (pH) which can reduce the composite resin toughness. **Aim** : To determine the acidity effect of fermented milk on the hardness of nanohybrid composite resin. **Method**: Experimental study with a post test control group design. There were 27 samples of nanohybrid composite resin. One time immersion for three seconds in each group of beverages namely Milk, Cimory, and Yakult. After 15 days, a composite resin hardness test was performed using a Micro Vickers Hardness Tester with a load of 100 grams for 10 seconds. Statistical tests using One Way ANOVA. **Results:** The nanohybrid composite resin exhibited significant reduction in hardness between three beverage groups. Post hoc LSD test showed that there were significant differences between Milk with Yakult ($p = 0.006$) and Cimory with Yakult ($p = 0.008$) while Milk with Cimory ($p = 0.907$) did not have significant. **Conclusions** : There is a effect of fermented milk influences the hardness. There is a significant difference between Milk and Yakult and between Cimory and Yakult and there is no significant difference between Milk and Cimory.
Keywords : Nanohybrid Composite Resin, Hardness, Fermented Milk

INTRODUCTION

Caries is the most common disease in the world.[1] The prevalence of dental caries in Indonesia is classified as high. Evidenced by the Basic Health Research (RISKESDAS) in 2018 from the Ministry of Health of the Republic of Indonesia which shows the prevalence of dental caries in Indonesia at 88.8%.[2] Caries is process of the teeth produced by bacterial interactions on the tooth surface. [3] Treatment for dental caries needs to be done to maintain tooth structure and prevent the occurrence of widespread tooth decay. One of the dental caries treatment is to do a restoration or dental fillings. There are several types of dental restorative materials including amalgam, composite resin, glass ionomer cement, and so on.[4-5]

Composite resin is a dental material that has good aesthetic and physical properties . Composite resins consist of three main components, which are organic polymer matrix, filler , and coupling agent.[6] Composite resins can be classified by filler particle size . One type of composite based on filler size is nanohybrid composite resin consisting of milled glass fillers and nano particles (40-50 nm).[5,7] Composite resins have several properties, one of which is mechanical properties. The mechanical properties of composite resins are influenced by the surface characteristics of composite resins, such as hardness, roughness and resistance to abrasion of the surface.[8] The ability of composite resin to resist the mastication activity can be seen from the hardness of the composite resin.[9] Hardness of composite resin can decrease due to acidic oral cavity conditions. Extrinsic sources that cause the oral cavity to become acidic are acidic foods and beverages.[10] The effect of acidic foods and beverages begins with the process of absorption of water

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which can damage the bond between the filler and the organic matrix. Organic matrix degradation is the release of methacrylate group bonds in bis-GMA because polymer resin composites have unstable bonds. Bonds of unstable composite resins are easily degraded by exposure to low pH because acids have more H^+ ions which can lead to decreased hardness of composite resins .[11, 13 - 18]

Fermented milk Yakult are often consumed as beverages in nowdays.[10]. Fermented milk Yakult certains Lactobacillus case which be used to maintain normal flora in the intestine. Yakult both of fermented milk and also has a low potential hydrogen which can reduce the composite resin hardness.[1 2]

Based on the background, this research needs to be done to find out and prove the effect of the acidity of fermented milk on the hardness of nanohybrid composite resins. This study also aims to provide information about the effect of the acidity of fermented milk on the hardness of nanohybrid composite resins.

MATERIAL AND METHODS

This type of research is experimental with the post test control group design. This research uses a composite material of Filtek ™ Z250 XT shades A2 nanohybrid resin formed using a metal ring mold with a diameter of 5 mm and a depth of 2 mm. The number of samples used in this study were 27 pieces divided into 3 groups: 9 samples immersed in Milk beverages (pH 6.9) as a control group, 9 samples immersed in Cimory fermented milk beverages (pH 4) as a treatment group and 9 groups immersed in Yakult fermented milk beverages (pH 3.5) as a treatment group. Before immersion, each sample beverage is incubated for 24 hours at 37 ^{o} C. After incubation, 20 ml of each beverage is immersed five times immersed using a nylon filter. One time immersion is carried out for three seconds. After immersion, soak the sample for three seconds in the mineral water. After that, soak the sample in artificial saliva with a volume of 20 ml for 24 hours at 37 ^{o} C. After 24 hours do re-immersion in a new beverage solution. The survey was carried out for 15 days. After 15 days the samples were tested for hardness using Micro Vickers Hardness Tester (VHN) with a load of 100 grams for 10 seconds.

This study uses the Saphiro Wilk normality test because the sample size is <50 subjects. Using One way Anova parametric test for data that has a normal and homogeneous distribution, to analyze the differences between groups, then will be followed by a post hoc LSD test.

RESULTS

Statistical data processing result obtained average value, deviation standard , median, maximum and minimum values as well as values of normality test that can be seen in table 1 .

Table 1. Data Characteristics Surface Hardness of Nanohybrid Composite Resins

Beverage Type	Amount of The Group	Mean ± SD	Median (Minimum- Maximum)	p value
Milk (VHN)	9	93,87 ± 11,05	98,83 (75,50-109,97)	0,656
Cimory (VHN)	9	93,33 ± 6,85	93.26 (83,27-107,20)	0,737
Yakult (VHN)	9	80,01 ± 10,81	82.13 (67,10-94,27)	0,208

* Shapiro-Wilk test

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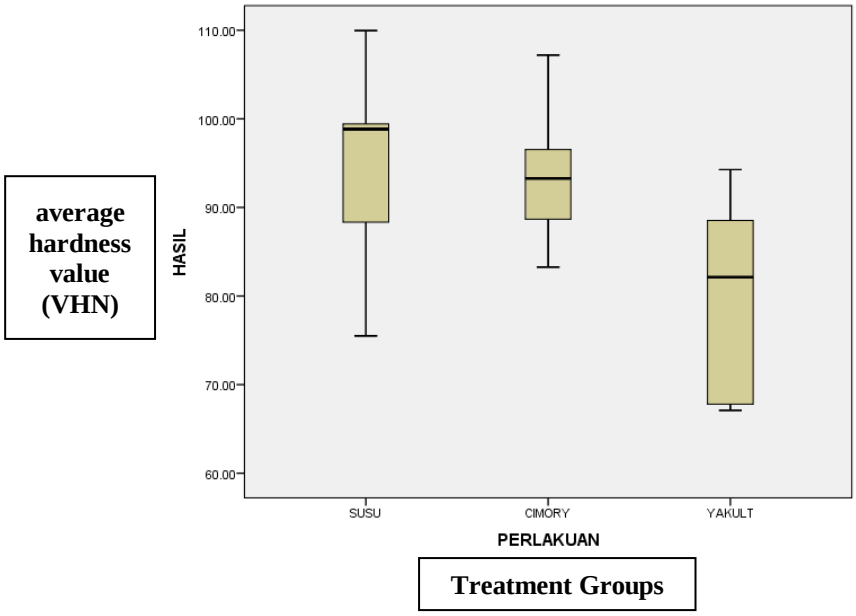

Figure 1. The mean value of surface hardness of nanohybrid composite resin.

Normal data distribution in this study using the *Shapiro-Wilk* with the value p > 0,05. Table 1 shows that the Milk, Cimory and Yakult treatment groups have a significant value of more than 0,05 which means that all treatment groups are normally distributed. Then proceed homogeneity test with homogeneity value of the data is 0,140 (p > 0,05) which means the data is homogeneous. *One Way Anova* test requirements are normal and homogeneous data distribution. The data in this study are normally distributed and homogeneous so that *One Way Anova* test can be continued . *One Way Anova* test was conducted to determine differences in the hardness of nanohybrid composite resins against the immersion of Milk, Cimory, and Yakult. Anova test results obtained with p = 0,009 (p < 0,05), which means there are significant differences in the hardness of nanohybrid composite resin between the three beverage groups.

The statistical test was continued using the *post hoc* test from the results obtained a significant difference in the hardness of the nanohybrid composite resin between the Milk group with Yakult and Cimory with Yakult (p < 0,05). However, no significant differences were found between the Milk and Cimory groups (p > 0,05).

Table 2 . *LSD Post hoc* test results in all beverage groups

	Beverage Group	
Beverage Group	**CIMORY**	**YAKULT**
Milk	0,907	0,006
Cimory	-	0,008
Yakult	0,008	-

* p post hoc test applies if p < 0, 05

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DISCUSSION

Anova test results obtained p = 0,009 (p < 0,05), which means there are significant differences in the hardness of nanohybrid composite resin in the three beverage groups. This is consistent with the research hypothesis which states that there is an influence of the acidity of fermented milk on the hardness of nanohybrid composite resin.

This is because the hydrolysis process which starts from water absorption then diffuses through the resin matrix and the surface of the filler process is accelerated due to low pH . Drinks that have a low pH or acid can cause the composite resin to become erosive so it causes the composite resin to decrease the hardness.[19-20]

This research is in line with Moraes CC Isabel et al., Which states that acids produced by probiotic fermented milk can significantly reduce the hardness of methacrylate-based composite resins. In this study one of the probiotic fermented milk drinks is Yakult.[13]

This study is also in line with the research of Khan Ahmed Aftab, et al who conducted research with a variety of drinks and with different pH including group A artificial saliva with pH 6,9, group B orange juice with pH 3,5, group C milk with pH 6,0 and group D coca cola with a pH of 2,7 . This research shows that drinks that have low pH can reduce nano composite hardness to be lower. In this study group C milk with pH 6,0 reduced the hardness of nano composites not too low compared to group B and group D.[21]

Based on the *post hoc LSD* test showed that there were significant differences between Milk with Yakult (p = 0,006) and Cimory with Yakult (p = 0,008) while Milk with Cimory (p = 0,907) did not have significant differences. Based on the results of this study the treatment groups dipped in the Yakult beverage (80,01 ± 10,81) reduced the hardness of nanohybrid composite resins which were greater than Milk (93,87 ± 11,05) and Cimory (93,33 ± 6,85) .

Acid has more H^+ ions which will cause its physical chemical bonds to become weak so that the composite resin matrix degrades and causes the composite resin to erode easily, thereby reducing the hardness of the composite resin.[11,22] Nanohybrid composite resins can undergo matrix polymer degradation by changing the composite microstructure into pores so that the monomers break out of the composite resin bond due to acidic drinks. One of the effects of the release of monomers is the reduction in the hardness of nanohybrid composite resin.[23]

This study is also in line with the study of Kafalia et al., Which illustrates that the results of the group of distilled water with carbonated drinks and orange juice with carbonated drinks have a significant difference but the distilled water and orange juice groups did not have significant differences. [11]

The research of Sitanggang Patar, et al. Showed a decrease in the hardness of composite resins in soaking lemon juice which has a pH of 1 , 7 at 60 and 120 minutes. While the lime juice immersion for 30 minutes in water that has a pH of 7 for 30, 60, and 120 minutes does not cause a decrease in the hardness of the composite resin. [24]

CONCLUSION

Based on research on the influence of the degree of acidity of fermented milk, the following conclusions are obtained:
The acidity of fermented milk influences the hardness of nanohybrid composite resin and there is a significant difference between Milk and Yakult and between Cimory and Yakult and there is no significant difference between Milk and Cimory.

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