



THE EFFECT OF CARBONATED, ISOTONIC, AND YOGHURT DRINKS TO THE HARDNESS OF BULK FILL COMPOSITE RESIN

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ABSTRACT

Background: Composite resin often used as a restoration material due to its advantages in the aesthetic field. The bulk-fill type is one of the composite resin that can be applied directly into cavities as deep as 4 mm, so that restoration procedure becomes easy and effective. Hence, exposure to various acidic drinks can reduce the hardness of composite resins and eventually lead to failure of the tooth restoration process. **Objective:** This research aimed to evaluate the effects of several commercial acidic drinks, (carbonated, isotonic, and yogurt) on the hardness of bulk-fill composite resins. **Method:** This research was an experimental study with a post-test control group design. Twenty-four specimens were made with the size 10 x 4 mm using the metal mold rings. Specimens were divided into 4 groups for artificial saliva (served as a control), carbonated, isotonic, and yogurt. Specimens were immersed in storage agents for 5 seconds followed by artificial saliva for 5 seconds. This cycle was repeated 20 times for 14 days. The bulk-fill composite resin hardness was measured using a Micro Vickers Hardness Tester with a load of 100 grams for 10 seconds. Statistical analysis was performed using One Way ANOVA and Post Hoc LSD **Results:** Data were normally distributed and homogeneous with $P > 0.05$. The One Way ANOVA test showed a significant difference in bulk fill composite resin between 4 groups ($P < 0.001$). The Post Hoc LSD test showed significant differences between all groups ($P < 0.001$). **Conclusion:** Carbonated, isotonic, and yogurt drink significantly decreased surface microhardness of bulk-fill composites resin. However, what has been proven to reduce the hardness value the most is carbonated drinks

Keywords: Carbonated beverage, Isotonic, Yogurt, Hardness

INTRODUCTION

According to the Basic Health Research 2018, the prevalence of dental caries was categorized as high in about 88,8 percent.¹ The treatment of dental caries that could be done was restoration. The material of restoration which most frequently used was composite resin because it has superiority in the aesthetic field. Currently, the new technology has introduced composite resin in bulk fill type which has several superiority than the previous types of composite resin. Besides, in the aesthetic field, the composite resin in bulk fill type was used to restore posterior teeth. This composite resin could be applied by employing the bulk technique, in which the composite resin would be applied directly into the cavity with a depth of 4 mm, therefore, the restoration could be done effectively and easily.²

The character of composite resin could be identified from mechanical properties as hardness. The hardness was the most important property if the individual has a wider masticated area. The hardness could also refer to endurance or restoration material to the hardness level of bulk-fill composite resin which was affected by polymerization shrinkage, and

acid foods or drinks.³ Furthermore, most of the acid drinks were from a type of soft drink that we could find around our population, for example, carbonated drink, isotonic drink, and yogurt.

The carbonated drink contained carbon dioxide to produce carbonic acid.⁴ The isotonic drink contained carbohydrates and minerals to replace body fluid and energy.⁵ While yogurt was a processed milk product which fermented in lactic acid bacteria.⁶ Those three kinds of the drink have a low acid level equally.

The exposure from those kinds of acid food and drink could reduce the hardness of the surface which impacted failure on the process of dental restoration.⁶ The decrease of hardness on the composite resin was due to the process of matrix degradation.³ The matrix degradation was referred to as the dissolution of methacrylate on bisphenol aglycidyl methacrylate (Bis-GMA) because it has an unstable relation, thus, it could be easily degraded when it was exposed to acid.⁴ Based on the description above the author wanted to know the effect of carbonated, isotonic and yoghurt drinks



immersion on the hardness of the surface of bulk-fill composite resin.

MATERIALS AND METHODS

Production of Composite Resin Sample

This research was categorized into experimental research which exerted post-test control group design. This research involved 24 samples which sized 10×4 mm and printed out in a metal mold ring. The samples were then divided into 4 groups: artificial saliva, carbonated drink, isotonic drink, and yogurt. All samples were soaked in each type of drink for 5 seconds and then in saliva for the other 5 seconds. The soaking process was repeated for 20 cycles along 14 days consecutively. After this soaking, the sample was incubated for 24 hours. After this treatment, it would be tested the hardness of bulk-fill composite resin by using Micro Vickers Hardness Tester.⁷

Hardness Measurement

The hardness value was determined by micro-hardness tester in pyramid indenter which pressed the surface of sample. Next, to create three curvatures on different point with load 100 gram and duration 10 seconds. Then, it would indicate the average value to determine the Vickers Hardness Number (VHN).

Statistical Analysis

This research exerted parametric test One Way ANOVA to analyze the hardness difference of bulk fill composite resins on four groups and post hoc LSD test to identify the difference among groups. The data analysis was done in computer program with significance level $P < 0,05$, and on credibility value 95%.

RESULTS

The result of pH measurements, carbonated drinks have the most acidic pH level of 2.3, while isotonic drinks have a pH level of 3.5, and yogurt has a pH level of 4-4.1. The effect of soaking on carbonated drink, isotonic drink, and yogurt to the hardness of bulk fill composite resin which would be presented on table 1.

Table 1. Mean, Standard Deviation, Median, Maximum, Minimum, and Normality Test of Bulk Fill Composite Resin Surface Hardness

Type of Group (n=6)	Mean \pm SD (VHN)	Median (VHN)	Minimum-Maksimum (VHN)	P Value
Artificial Saliva (Control Group)	114,24 \pm 5,57	112,85	108,17 - 121,73	0,389
Yogurt Drink	78,82 \pm 3,915	77,68	74,80 - 84,57	0,381
Isotonic Drink	69,72 \pm 5,041	70,21	62,27 - 75,37	0,662
Carbonated Drink	46,42 \pm 4,332	47,02	39,17 - 51,63	0,849

* Normality test $P > 0,05$; significant

Based on table 1, the yogurt, isotonic, and carbonated drink were in hardness decline of bulk-fill composite resin from the control group, artificial saliva. The hardness value from the highest to the lowest consecutively 114,24 \pm 5,57 VHN (artificial saliva), 78,82 \pm 3,915 VHN (yogurt drink), 69,72 \pm 5,041 VHN (isotonic drink), and 46,42 \pm 4,332 VHN (carbonated drink).

Table 2. One Way ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14269,960	3	4756,653	210,121	,000
Within Groups	452,754	20	22,638		
Total	14722,714	23			

*Significantly ANOVA $P < 0,001$

The result of the One Way ANOVA test showed a P -value $< 0,001$ which referred to a significant difference in bulk-fill composite resin hardness among four groups. The post hoc LSD test was employed to identify the difference of hardness value among a treatment to other treatments. Based on the result of the post hoc LSD test, table 3 would present the significant difference in bulk fill composite resin hardness among all group types with a significance value $P < 0,05$.



Table 3. *P*-Value, Post Hoc LSD Test Result on Four Groups

Treatment	Groups			
	Saliva	Yogurt	Isotonic	Carbonated
Artificial Saliva	-	<0,001	<0,001	<0,001
Yogurt Drink	<0,001	-	0,003	<0,001
Isotonic Drink	<0,001	0,003	-	<0,001
Carbonated Drink	<0,001	<0,001	<0,001	-

* Post hoc LSD $P < 0,05$; significant

Consecutively, the artificial saliva was in the control group, carbonated drink group with similar significance value ($P < 0,001$), isotonic, and yogurt drink ($P = 0,003$). Based on the result of post hoc LSD test $P < 0,05$ which referred to the significant difference in the hardness of bulk-fill composite resin among all kinds of treatment.

DISCUSSION

Based on the result of One way Anova test, $P < 0,001$ referred to the significant difference among the four groups, as saliva, yogurt, isotonic, and carbonated groups. The carbonated drink was the most type which reduces the hardness of bulk-fill composite resin than isotonic or yogurt drink. This condition was because the carbonated drink has the most acid pH level 2,3, while isotonic drink has pH level 3,5, and yogurt has pH level 4-4,1.

The carbonated drink contained carbon dioxide on low concentration (up to 1,0%), it was enough to form carbonic acid (H_2CO_3) which could reduce the acidity level.⁸ Moreover, the isotonic drink contained carbohydrates, minerals, and water. Other contents of mineral or electrolyte as sodium, potassium, chloride, phosphate and fruit flavoring, and citric acid which was able to produce a low pH level.⁹ Next, a yogurt drink was a drink which came from the fermentation process of lactic acid by *Streptococcus thermophiles* and *Lactobacillus bulgaricus* bacteria. The duration length of the fermentation process would impact the decrease of pH level on yogurt with a typical sour taste.¹⁰

This result was in line with the research done by Ahmed M Elmarakby, et al. which have demonstrated 5 groups and cola-carbonated drink groups which significantly affected and reduced the hardness of the dental surface (enamel and dentin)

and some materials of aesthetic restoration.¹¹ Saijai tanthanuch, et al. in their research have stated 5 groups of passion fruit juice that have the lowest pH level on that research group, which then affected the biggest significant change in the difference value of average micro-hardness for all materials.¹²

The strong acidity which contained ion H^+ would dissolve restoration materials as bulk-fill composite resin. The dissolution process of restoration materials was a process of matrix degradation. The ion H^+ excess would cause the chemical bond of matrix polymeric of unstable composite resin in the form of methacrylate release on Bis-GMA because of the relation between cross-link and ion H^+ .^{13,14} The dissolution of polymeric bound was due to the degradation which caused the formation of residual monomer if it was exposed by oral cavity fluid or anything with acidity content.⁴

According to Erdemir Ugur, et al., the composite resin which was soaked into low pH levels would produce high solubility which could cause erosion on the surface and affect hardness.³ Furthermore, Aftab Ahmed Khan, et al., have asserted that the consumption of soft drink around our society was the potential source of erosion and degradation for composite resin material. The length when that drink has been contacted to the tooth, saliva buffer power, and pH level became the determinant factors to process erosion on the dental surface.⁶

In this research, finishing and polishing steps were able to influence the hardness of composite resin. The softer surface would determine little water absorption within composite resin restoration.¹⁵ Moreover, the finishing and polishing result still left the spot or line on the surface, then it looked rough. This condition was due to the short duration of the finishing and uneven process.¹⁶ In addition, the abrasive material has a different shape and size. The small size and sharp shape of abrasive material were aimed to improve erosion on the composite resin surface.

CONCLUSION

The soaking process of composite resin on carbonated, isotonic, and yogurt drinks was in a significant decrease in hardness value. The carbonated drink was the most type which could reduce the hardness value of bulk-fill composite resin since it contained the lowest pH level 2,3.



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