



## THE EFFECT OF SUBMERSION IN ORANGE JUICE AND FERMENTED MILK ON COLOR CHANGES OF NANOHYBRID COMPOSITE RESIN

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### ABSTRACT

**Background:** Color changes in nanohybrid composite resins can occur due to 2 factors, intrinsic and extrinsic factors. Beverage can be the one of the extrinsic factor such as orange juice and fermented milk. The pH content of this both of drink will affect the change in color of the composite resin. Low pH conditions will cause the release of H<sup>+</sup> which has an impact on the degradation and breaking of polymer chain bonds. **Aim:** To determine the effect of orange juice and fermented milk on the color change of nanohybrid composite resin. **Methods:** An experimental study with the post test control group design and a total sample of 6 samples. Soaking for 24 hours at 37°C in artificial saliva, orange juice, and fermented milk. After 24 hours the color changes were measured using a colorimeter. Statistical test using independent t-test. **Results :** Significant differences in color changes in nanohybrid composite resins between the two sample groups (p = 0.00). Independent t-test showed the results of a significant difference between 2 groups. **Conclusion:** There was a significant difference between orange juice and fermented milk in changing color of nanohybrid composite resin.

**Keywords:** *Nanohybrid composite resin, Color change, Orange juice, Fermented milk.*

### INTRODUCTION

Cavity patching or crown making is a concept of dental maintenance particularly in oral cavity within a long time period despite of its damage. This method is done to protect from bacteria and acids that irritate the pulp.

The composite resin is a material of dental restoration which has been used to replace the lost tooth structure as well as modify the tooth color and contour with aesthetic purpose. The recent discovery on composite resin is currently a type of Nano hybrid composite. The Nano hybrid composite is consisted of particles in micrometer and nanometer size and used as a composite of either anterior or posterior restoration generally. This composite is also used as a need of restoration aesthetic, which is very suitable for the posterior area which requires to a big density and anterior area. Moreover, the type of Nano metric composite has a size from 0,1 up to 100 nm. The main purpose of filler which exerts size of nano metric dimension is to increase strength, wear resistance, and easy of polishing step. The material used for the restoration must have enough strength to resist the pressure during mastication.

The coloring on composite resin is divided into two factors, intrinsic and extrinsic factor. The intrinsic factor depends on the chemical-physical reaction on the restoration. While, the extrinsic factor which affects can be in the form of plaque accumulation, polymerization contraction,

environmental factor exposure, and food and beverage coloring. The extrinsic factor of discoloration is then divided into three mechanism, production of coloration components in the plaque because of chromogenic bacteria, attachment of coloration substance from food ingredients through the oral cavity, and coloring formation from the chemical process of pellicle component. Research in the Department of Restorative Dentistry and Endodontic, Ege University, School of Dentistry, 35100 Izmir, Turkey proves that the color change is coming up after soaking process in a solution for 1, 3, 5, and 7 days, which is equivalent to the individual who needs about 15 minutes for every time he drinks. The length of a day soaking is equivalent to (1 X 24 hours X 60 minutes) divided by 15 minutes per day = 96 days, it is approximately equivalent to the usage for three months.

The kinds of drink which can be one of extrinsic factors of coloration on composite resin are orange juice and fermentation milk. Those two drinks are the popular beverage in the society. The orange juice has pH content 2,8. While the fermentation milk has lactic acid content and pH 3,2-4,8. The low pH content can impact the extrication of H<sup>+</sup> which will raise to degradation and breaking of polymer bonds. The degradation and breaking of polymer bonds will affect to microcracks and microvoids which is located between the filler and resin matrix



can be the access of pigment penetration into composite resin.

The composite resin which has been exposed by a long time chemicals affects the composite resin to worn-out and matrix degradation which then affects to the roughness of composite resin surface. The rough surface of composite resin will make the pigment on food and drink stick easily. The composite resin with a small filler will affect the surface smoothness of composite resin. Thus, the food and pigment will be harder to stick on the surface of composite resin.

Based on the research backgrounds, this research is conducted in order to identify and prove to effects of orange juice and fermentation milk soaking to the change of nano hybrid composite resin and also to provide information about the effects of orange juice and fermentation milk soaking to the change of nano hybrid composite resin.

## METHODS

This is experimental post-test control group design research. We used Filtek™ Z250 XT shades A2 nano hybrid composite resin which was formed by exerting metal ring mould in diameter 10 mm and

depth 2 mm. The total sample in this research were 10 pieces which then divided into 2 groups, 5 samples which would be soaked into orange juice (pH 2,7) and 5 samples would be soaked into fermentation milk (pH 3,9). Those two groups was measured first before the process of soaking, and the soaking process of both groups needed approximately 20 ml on each group for 24 hours and incubation process on temperature of 37°C. After 24 hours, the sample was measured its discoloration through colorimeter.

This research used normality test of Saphiro Wilk because the sample were < 50 subjects. The homogeneity test was done by using Lavene's test which aimed to find the data variance. The data is in normal distribution and homogenous. Next, the parametric test of independent t-test was used to see the significant difference between two groups.

## RESULTS

The result of statistical data processing showed the mean value, standard deviation, median, maximum and minimum value and normality test value could be seen on table 1.

**Table 1.** The Characteristics Data of Surface Roughness of Nano Hybrid Composite Resin

Type of Drink	Total Sample	Mean ± SD	Median (Minimum-Maximum)	P Value*	P Value**	P Value***
Orange juice	3	ΔE 2.45 ± 0.25	2.46 (2.15-2.80)	0.98		
Fermentati on milk	3	ΔE 1.20 ± 0.05	1.20 (1.14-1.25)	0.74	0.06	0.00

\* Saphiro-wilk test

\*\* Lavene's test

\*\*\* Independent t-test

The normal data distribution in this research exerted Shapiro-Wilk (p value < 0,05). On the table 1, it illustrated that the group of orange juice and fermentation soaking have significant value, the value was greater than 0,05 which referred that all treatment groups were normally distributed. Next, the homogeneity test with the value of data homogeneity 0,06 (p > 0,05) referred that the data was homogeny. The result of independent t-test were normal data distribution and data homogeneity. The data on this

research was normally distributed and homogenous, therefore continued whit to independent t-test. The independent t-test was done in order to identify the difference of discoloration on Nano hybrid composite resin to the orange juice and fermentation milk soaking. This research found significant difference of discoloration on nano hybrid composite resin between the two groups of drink type (p < 0,05) .



## DISCUSSION

The result of independent t-test indicated p value = 0,00, which was referred to the significant difference of discoloration on nano hybrid composite resin between two groups of drink. This result was in line with the research hypothesis which asserted the effect of orange juice and fermentation milk soaking to the discoloration on nano hybrid composite resin.

The soaking of nano hybrid composite resin on each group of orange juice and fermentation milk was done for 1 day which aimed to indicate the greater discoloration on orange juice group that has shown discoloration on composite resin. The low pH condition would raise to the discoloration on composite resin, because the acidity was able to soften matrix on the resin, and surface degradation which was able to help the absorption of color pigment. The matrix degradation affected to a crack between the filling material and resin matrix which were the access of pigment into composite resin. Moreover, the composite resin which has been exposed by chemicals continuously would affect the composite resin to wear out and then impact to the roughness of composite resin surface. The rough surface of composite resin caused the pigment on food and drink stick easily.

This recent research finding was in line with the research done by Ali et al. which has proposed that the orange juice has citric acid malic acid content which could affect the matrix softening, which then helped the absorption of color pigment and stain. On that research, the researchers said that the orange juice has significant statistic of discoloration, and this result was followed by the guava juice. Topcu, et al. have discovered the discoloration on composite resin which was affected by several kinds of juice drink and other colored drinks as cola and wine. In addition, this research was also in line with the research by Ibstisyaroh which has stated the discoloration of composite resin after fermentation milk soaking for 6 hours, 12 hours, and 18 hours. The longer time of soaking, the higher possibility of discoloration on composite resin.

Significant discoloration showed in group of orange juice soaking, perhaps it was because the acidity of orange juice contained pH level 2,7. Some monomers of residual and resin would throw off as well as the nano particle of filling material. The ascorbic acid was oxidized and formed dehydroascorbic acid and would be further oxidized

into 2,3- ketogulonat acid. The compound of 2,3- ketogulonat acid was decomposed into furfural and form color pigmentation and release CO<sub>2</sub>. While, the acid within fermentation milk contained pH level 3,9. The content of lactic acid in fermentation milk caused to the low pH content in the fermentation milk. The chemical formula of lactic acid was C<sub>3</sub>H<sub>6</sub>O<sub>3</sub>. The excess of ion H<sup>+</sup> in acids could affect the breaking of bonds among polymers. H<sup>+</sup> was also able to bind ion COO<sup>-</sup> on CO<sub>2</sub>CH<sub>3</sub> group of polymer which then affect the breaking into COOH and CH<sub>3</sub>. H<sup>+</sup> was also able to break the double bonds of dimethylacrylate on principal monomer. This condition would affect matrix degradation and breaking of polymer bonds on ester group. The ester could be hydrolyzed by water on the situation when acid would produce carboxylic acid and alcohol. The low pH content influenced the integrity of composite resin surface that would break away with the nano particle of filling material. This condition also affected the composite resin to be rough on the composite resin which eased the color absorption on composite resin. The acid contained a lot of ions H<sup>+</sup>, the more acidic on a solution would determine many ion contents, which then dissolved the material. The material of composite resin which has been soaked into acidic liquid has the high solvability which could cause erosion on the composite resin surface. This situation could affect the worn out composite resin and cause the decrease of composite resin surface roughness. Further, the rough surface of composite resin would make the color pigment on food and drink sticks easily.

The mechanism of discoloration could be explained by the characteristic of composite resin which could absorb and distort the liquid. The absorbed liquid was the carrier factor of discoloration. The composite resin which absorbed water would absorb other liquids and then cause to the process of discoloration. The matrix component of composite resin has hydrophilic nature which caused absorptive and adsorptive on the composite resin.

## CONCLUSIONS

This research found that the effect of discoloration on composite resin during orange juice soaking was bigger than in fermentation milk soaking.



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