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Research Report

The effect of nano propolis on surface color changes of nanohybrid composite resins

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ABSTRACT

Background: *Nanohybrid composite resins have many advantages, but one disadvantage is their absorbent nature which can lead to discoloration. Phenols and flavonoids in nano propolis cause diffusion and affect the matrix and pigments of nanohybrid composite resins. The accumulation of reduction-oxidation reactions causes new compounds of nanohybrid composite resins to occur so that they have different colors.* ***Purpose:*** *The study was conducted to determine the changes in surface color of nanohybrid composite resin after immersion in nano propolis at 5% concentration.* ***Methods:*** *Research experimental laboratory method with pre and post test design was applied to 25 nanohybrid composite resin fruit samples of size (5x5x1.5) mm embedded in bovine incisive, then immersed in 5% nano propolis and 25 ml of distilled water at 37oC for five days. The color change (ΔE) was measured with a DSLR camera and processed with Adobe Lightroom Classic software in CIE L*a*b* format.* ***Results:*** *The anova test on ΔE in the data showed the p-value of sphericity assumed was smaller than 0.05. There is a difference in the average measurement results on the first day to the fifth day in the treatment group. Independent t-test of control and treatment data showed a significant difference in measurement results. The results of the post hoc test with the Tukey method showed that the treatment groups at 4x24 hours and 5x24 hours did not have significant differences. P-value at 4x24 hours and 5x24 hours was 0.957.* ***Conclusion:*** *There was a change in the surface color of the nanohybrid composite resin after being immersed in a nano-solution of propolis with a concentration of 5%.*

Keywords: *discoloration, composite resin, nanohybrid, bovine incisive, nano propolis*

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INTRODUCTION

In the development of science and technology, composite resin has become the main choice for dental restoration because of its ability to replace tooth structure and improve aesthetics[1]. However, composite resin tends to experience discoloration in the oral cavity, becoming a reason for replacing the resin filling. To improve the physical, mechanical and aesthetic properties of composite resins, new types have been developed, such as nanohybrid composite resins.[2,3]

Nanohybrid composite resin has nanoparticles with a size of 0.04 µm, providing advantages but also disadvantages, such as liquid absorption properties that can change color.[4] Color changes in composite resin can come from intrinsic factors, such as oxidation in amine accelerators, and extrinsic factors, including eating, drinking, smoking and poor oral hygiene.[5]

Several studies have shown color changes in nanohybrid composite resin after soaking in various solutions, such as coffee, tea, and black vinegar.[6-8]

Studies also evaluated the effect of propolis on the color change of dental crowns, showing significant results in combination with calcium hydroxide. Although there has been a lot of previous research on composite resins, color changes, and the influence of propolis, specific research on the effect of nano-propolis on color changes in nanohybrid composite resins is still limited. Therefore, this research will focus on the effect of nano propolis on changes in surface color of nanohybrid composite resin after being soaked in nano propolis for a certain period of time.

MATERIALS AND METHODS

This research is a laboratory experimental type research with a Pretest-Posttest Group Design research design. This research has permission from the Health Research Ethical Clearance Commission, Faculty of Dentistry, Airlangga University with number 1392/HRECC.FODM/XII/2023. This research was conducted at the Research Center Laboratory, Faculty of Dentistry, Airlangga University,

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Surabaya in October – November 2023. The sample required for this research is a disc-shaped composite resin with a diameter of 10 mm and a thickness of 2 mm. The sample population is calculated using the Federer formula. The tools needed for this research are diamond-coated disc, round diamond bur, inverted bur, syringe, plastic filling instrument, DSLR camera, camera tripod, 100 mm macro lens, ring flash, polar filter, Adobe Lightroom Classic software. The materials used in this research are nano propolis, sterile saline liquid, nanohybrid composite resin filling material.

Sample making began with creating a cavity measuring 5 mm x 5 mm x 1.5 mm using a round bur and an inverted bur on the bovine incisor tooth. Followed by taking photos before treatment, then soaking the samples using nano propolis solution at a temperature of 37ºC for 24 hours in a closed position. Then the next nanohybrid composite resin sample is put into a petri dish (according to group) which will be treated with nano propolis at a temperature of 37ºC for 24 hours, facing upwards so that it comes into contact with the liquid during soaking. The nano propolis solution is replaced with a new one every 24 hours. With each replacement of the nano propolis, the sample is cleaned with running water for two seconds after which it is put back in the petri dish to be soaked again. Then, in the final step, photos are taken after treatment to be processed using Adobe Lightroom Classic software. Color changes are measured using the L*a*b method to obtain the ΔE value. The results of each group's calculations were analyzed using IBM SPSS Statistics Ver. 25.

RESULTS

Data was taken from four points on the composite resin and then averaged to the L*a*b* values obtained. There are six groups of bovine incisive L*a*b* samples that will be analyzed, namely (P1) 1x24 hour immersion data, (P2) 2x24 hour immersion data, (P3) 3x24 hour immersion data, (P4) 4x24 hour immersion data, and (P5) 5x24 hour immersion data. Overall, there were five treatments for the groups tested (Table 1). The L*a*b* values were grouped into two data groups, namely the control L*a*b* group and the research (treatment) L*a*b* group. After obtaining the L*a*b* values for each treatment group, the ΔE (color change) value for each treatment was calculated for the 25 samples used.

DISCUSSION

Based on the research results, it was found that the surface color change pattern of the specific nanohybrid composite resin was firm and clear. There is a change in the L* value (representation of change towards darker/black), there is a change in the a* value (representation of change towards reddish) and there is a change in the b* value (representation of change towards bluish). The color change pattern in this study is in line with previous research conducted by Hasan in 2009, a solution containing phenols and flavonoids for 1 x 24 hours is identical to the use or exposure to a solution containing polyphenols and flavonoids for 1 year of use, carried out twice for 30 seconds in one use of mouthwash.[9] This research using the CIE L*a*b* method also supports other research conducted by Premesthi in 2019, namely that there is an effect of changing the color of nanohybrid composite resin on immersion using colored carbonated drinks.[10]

Nano propolis contains important organic compounds in propolis, phenols (polyphenols) and flavonoids that can influence the surface roughness of restorations. This condition can disrupt the integrity of the nanohybrid composite resin, causing porosity. The porosity conditions

Table 1. Results

Group		Mean Difference	p	Differences in Color Changes of Composite Resin Surfaces
P1 (1x24 hours)	P2 (2x24 hours)	-2.24160	0.000	Significant
	P3 (3x24 hours)	2.22480	0.000	Significant
	P4 (4x24 hours)	9.21720	0.000	Significant
	P5 (5x24 hours)	8.91160	0.000	Significant
P2 (2x24 hours)	P1 (1x24 hours)	2.24160	0.000	Significant
	P3 (3x24 hours)	4.46640	0.000	Significant
	P4 (4x24 hours)	11.45880	0.000	Significant
	P5 (5x24 hours)	11.15320	0.000	Significant
P3 (3x24 hours)	P1 (1x24 hours)	-2.22480	0.000	Significant
	P2 (2x24 hours)	-4.46640	0.000	Significant
	P4 (4x24 hours)	6.99240	0.000	Significant
	P5 (5x24 hours)	6.68680	0.000	Significant
P4 (4x24 hours)	P1 (1x24 hours)	-9.21720	0.000	Significant
	P2 (2x24 hours)	-11.45880	0.000	Significant
	P3 (3x24 hours)	-6.99240	0.000	Significant
	P5 (5x24 hours)	-0.30560	0.957	Not Significant
P5 (5x24 hours)	P1 (1x24 hours)	-8.91160	0.000	Significant
	P2 (2x24 hours)	-11.15320	0.000	Significant
	P3 (3x24 hours)	-6.68680	0.000	Significant
	P4 (4x24 hours)	0.30560	0.957	Not Significant

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of the nanohybrid composite resin and the content of nano propolis dye cause diffusion absorption in the nanohybrid composite resin. The redox reaction (reduction - oxidation) that occurs is a type of chemical reaction that can cause color changes such as those that occur in the process of immersing the nanohybrid composite resin in a nano propolis solution. The oxidation process occurs when phenols and flavonoids can enter the composite resin structure and release molecules containing discoloration. The reduction process occurs when the composite resin receives electrons from nano propolis.[10-12]

In conclusion, based on the research, it is proven that there is an influence of nano propolis on changes in the surface color of the nanohybrid composite resin after being soaked in a nano propolis solution with a concentration of 5% over a certain period of time. The use of distilled water as a soaking agent for nanohybrid composite resin does not have a significant effect, it tends to be negligible.

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