

Research Article

INVESTIGATION OF DIFFERENT PEDIATRIC MULTIVITAMINS AND MINERAL SUPPLEMENTS ON THE COLOR STABILITY OF RESIN-BASED RESTORATIVE MATERIALS

 Aslı AŞIK^{1*},  Sibel ACAR¹,  Özant ÖNÇAĞ²

¹Department of Pediatric Dentistry, Faculty of Dentistry, Izmir Tınaztepe University, Izmir, TURKIYE

²Department of Pediatric Dentistry, Faculty of Dentistry, Ege University, Izmir, TURKIYE

*Correspondence: asli.asik@tinaztepe.edu.tr

ABSTRACT

Received: 08 May 2025

Revised: 03 July 2025

Accepted: 05 August 2025

Published: 22 September 2025



Copyright: © 2025 by the authors. Published by Aydın Adnan Menderes University, Faculty of Medicine and Faculty of Dentistry. This article is openly accessible under the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

Aim: This study aimed to investigate the effect of different pediatric multivitamins and mineral supplements on the discoloration of various resin-based restorative materials.

Materials and Methods: Forty samples of nanohybrid (Charisma Topaz, Kulzer, Germany) and 40 samples of microhybrid (Charisma Classic, Kulzer, Germany) composite resin were prepared with standard size molds. Baseline color measurement (T1) was made from each sample based on CIE $L^*a^*b^*$ system. Each sample was immersed in four different pediatric multivitamin and mineral supplements (iron, *Sambucus nigra*, resveratrol, propolis and distilled water) for 7 days. Color differences in each specimen were assessed using ΔE^* values measured with a spectrophotometer on day-1 (T2) and day-7 (T3). One sample from each group was randomly selected and stereomicroscope images were obtained and surface roughness evaluated. Normal distribution was checked by Shapiro Wilk test and then repeated measures ANOVA was employed for statistical analysis. Statistical significance was defined at 0.05.

Results: In nanohybrid and microhybrid composites, statistically significant color change was observed between ΔE_2 with ΔE_1 and ΔE_3 for resveratrol and propolis solution ($p < 0.001$ and $p < 0.001$). In nanohybrid composites, the highest color change difference between baseline and day-7 (ΔE_2) was observed in the resveratrol group (28.26 ± 4.93), while in microhybrid composites, it belonged to the propolis group (26.82 ± 5.44). Propolis solution discolored the microhybrid composite statistically significantly more than nanohybrid composite for ΔE_2 . There is no statistically significant difference between the color change of microhybrid composites and nanohybrid composites for other solutions.

Conclusion: The color and surface of resin-based restorative materials are esthetically unacceptably changed by long-term usage of multivitamins in particular containing resveratrol and propolis.

Keywords: Dental composites, discoloration, pediatric multivitamins, propolis, resveratrol

INTRODUCTION

Vitamins are organic micronutrients that the human body cannot produce on its own, are supplemented in healthy individuals by external intake through food, and cause disorders and disease in the body when not taken sufficiently. Vitamins regulate metabolism and support immunity by providing additional benefits such as body function, cell renewal and energy production. In case of deficiency, they should be taken from outside to meet the body's needs. There is supporting evidence that a several vitamins play an important role in the development and function of the immune system. Inadequate intake of antioxidant vitamins can lead to clinically significant immunodeficiency and infections in children (1,2).

Minerals, like vitamins, are elements that the body needs; they are necessary for the healthy fulfillment of body functions. Unlike vitamins, minerals are inorganic substances. Since the human body cannot produce minerals itself, they must be taken through food and/or in the form of supplements. They play a role in bone development, in the control of body fluids inside and outside the cell and in the conversion of the food we eat into energy (2). The requirements for these nutrients increase during children's growth periods and the accompanying increased energy needs (1). There are many products available for pediatric usage as multivitamins and mineral supplements with different ingredients sold over the counter. One of these is propolis, also called bee glue, which is used for therapeutic properties. Records indicate that propolis reduced blood pressure, enhanced immunity, and alleviated skin disorders and allergies. The bioactive phytochemical compounds that make up propolis contribute to its immune-boosting and antioxidant properties (3). Another common supplement used in childhood is iron-containing ones. In developing countries, anemia is thought to affect 46% to 66% of children under 4 years old, with iron deficiency accounting for half of all cases of anemia. In addition to anemia, iron deficiency also has a negative impact on developing cognitive skills and the growth of brain(4). Iron supplements are used in children to prevent hematological diseases, support brain development and increase attention (5). *Sambucus nigra* is a type of berry, and is often included in supplements ingredients. Flavonoids, triterpenes, acyl spermidines, α -linolenic acid, linoleic acid, mucilage, and derivatives of hydroxycinnamic acid are among the many components found in *Sambucus nigra* berries. The components in its content have antimicrobial and antiviral properties against influenza viruses and are immune boosting (6). Natural phytochemicals called

phenolic compounds have been shown to provide a host of health advantages presently. Among these compounds, resveratrol and quercetin have attracted the greatest interest lately as a result of their established antioxidant properties. Resveratrol (3,5,4' -trihydroxytrans-stilbene) is a small polyphenolic component found especially in red grapes and have properties such as antioxidant and anti-inflammatory (7). Multivitamins and mineral supplements come in a variety of formats, including pills, liquids (syrup), lozenges, chewable tablets, and effervescent tablets. Syrup version is the most preferred for pediatric usage. Multivitamins and mineral supplements are not used for a short period of time like other pediatric drugs (antibiotics, analgesics, antiepileptics etc.) and should be used regularly for a long time (8).

There are studies investigating the anticariogenic and erosive effects of pediatric drugs on tooth surfaces due to their sugar content (9–11). Also, there are several studies in literature evaluate the color change of restorative materials due to pediatric drug usage (12–17). Studies evaluating the effect of especially pediatric multivitamins and mineral supplements on tooth-colored resin materials are limited in the literature (18). The most important advantage of resin-based restorative materials is that they are compatible with tooth color and provide superior aesthetic appearance. However, discoloration of resin-based restorative materials may occur over time according to the internal and external factors (19). The research question of this study is whether pediatric multivitamin and mineral supplements cause discoloration and surface change on resin-based restorative materials.

Spectrophotometry, colorimetry and digital cameras are used for color change measurement in the studies. In spectrometry, which is the most frequently used method, L, a and b values are determined according to the 'Commission Internationale de l'Eclairage' (CIE) system. L value indicates the brightness or lightness of the color, a value indicates the greenness or redness of the color, and b value indicates the yellowness or blueness of the color (20).

This study aim to investigate the effects of various of pediatric multivitamins and supplements on the color stability and surface roughness of nanohybrid and microhybrid resin composite. The hypotheses of this study were considered as follows: (a) pediatric multivitamin and supplements type would affect the color stability and surface roughness of resin based restorative materials (b) nanohybrid composites are more resistant to color change than microhybrid composites.

MATERIALS AND METHODS

Four liquid multivitamins commonly administered to children were tested in the present study are shown in Table 1. The resin-based restorative materials evaluated for discoloration and surface roughness in the current study are shown in Table 2.

with a brush, washed and dried, and the color was measured (T2).

Prior to performing any measurements, the spectrophotometer was positioned in the middle of each specimen and calibrated using its own calibration

Table 1. Pediatric multivitamins and mineral supplements used in the present study

Pediatric Supplements	Manufacturer	Ingredients	Lot No
Ocean Microfer	Orzaks İlaç ve Kimya San.Tic.,Istanbul,Turkey	Deionized water, grape molasses, lipofer (corn starch, ferric pyrophosphate, hydroxypropyl methylcellulose, lecithin), flavor enhancer: xanthan gum, preservative: (potassium sorbate, sodium benzoate)	032310346
Sambucol Kids	Pharmacare Europe Inc.,UK	Glucose Syrup, black elderberry juice (<i>Sambucus nigra</i>), vitamin c (ascorbic acid), acidity regulator: citric acid, preservative: potassium sorbate	606201
Resverol	Armin İlaç ve Medikal, Izmir, Turkey	Resveratrol, quercetin, vitamin c, forest fruit flavor,water,gliserol	RS1123
BEE'O UP Propolis	SBS Bilimsel Bio Çözümler San. ve Tic., Istanbul, Turkey	100% orange juice (60%), raw honey (35%), Pure Anatolian Propolis (5%)	PBCSU22011

Power analysis was performed by G*Power 3.1.9.4 program (Heinrich Heine, University of Düsseldorf, Germany) to determine the number of samples to be used in the study and calculated as $n=80$ ($\alpha = 0.05$, $1 - \beta = 0.80$, effect size of 0.4). A total of 80 specimens (4 mm diameter and 2 mm in height) were prepared using a standard size mold. 40 were prepared with nanohybrid composite (Charisma Topaz, Kulzer, Germany) and 40 with microhybrid composite (Charisma Classic, Kulzer, Germany). Composite specimens placed as a single layer, stripped and polymerized for 20 seconds using a LED (Woodpecker LED-C, Woodpecker Medical Instrument Co., Guilin, China) in standard mode (1000 mW /cm²).

All of the specimens were polished by using aluminum oxide disc (Sof-Lex, 3M ESPE, St. Paul, MN, USA) and stored in distilled water for 24 hours. Before immersion to different pediatric multivitamins and mineral supplements all of the specimens color measurements were done for get a baseline value (T1) by using Vita Easy Shade Compact (Vita Zahnfabrik, Bad Sackingen, Germany). Each composite groups were divided to 5 subgroups ($n=8$) (iron, *Sambucus nigra*, resveratrol, propolis and distilled water) (Figure 1) and each specimens keeping in Eppendorf tubes (1.5 ml) with different solutions for 24 hours. After being kept in the solutions, the surfaces of the samples were gently cleaned

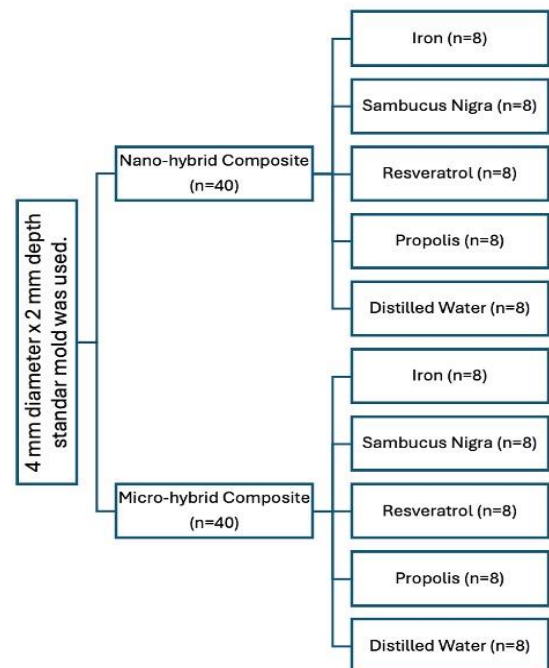


Figure 1. Groups of study

Table 2. Compositions of the resin-based restorative materials

Restorative Materials	Type	Composition	(%)Volume	Particle Size	Lot Number	Manufacturer
Charisma® Classic (Shade A1)	Microhybrid composite resin	Filler: barium aluminum fluoride glass Base resin: Bis-GMA	61 vol%	0.005–10 µm	M010742	Kulzer GmbH, Hanau, Germany
Charisma® Topaz (Shade A1)	Nanohybrid composite resin	Filler: Barium Aluminum Fluoride glass, pre-polymerized fillers, highly discrete nanoparticles Base resin: TCD-DI-HEA	59 vol%	5 µm	M010205	Kulzer GmbH, Hanau, Germany

equipment. Color measurements were performed under standard D65 light illumination and white background. For each sample, the color measurements were carried out according to CIE (L^* , a^* , b^*) system, repeated three times and average was recorded. If ΔE is 3.5 and above, clinically noticeable color change is mentioned. ΔE below 3.5 refers to clinically acceptable discoloration (21).

The color changes (ΔE^*) in baseline (T1), after 24 hours (T2) and 7 days (T3) of storage in three-dimensional $L^*a^*b^*$ color space is calculated with following formula;

$$\Delta E^* = ((\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2)^{1/2}$$

ΔL^* represents the variation between the L^* values

Δa^* represents the variation between the a^* values

Δb^* represents the variation between the b^* values

One sample from each group was selected, images were obtained with Stereo Microscope (Leica MZ16; Leica Microsystems, Wetzlar, Germany) 7 days after immersion, and surface roughness was evaluated.

Statistical analysis

Analyses were performed in IBM SPSS 25 program (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY, USA). Mean, standard deviation and median were calculated using descriptive statistics. The assumption of normal distribution was checked by Shapiro Wilk test, homogeneity of variance by Levene's test and sphericity assumption by Mauchly's W test. Repeated Measures ANOVA (Greenhouse-Geisser Statistics) test was performed to examine the difference between the averages of the three dependent groups in which the normality assumption was met with the interaction effect. Post Bonferroni tests were used to reveal the group or groups that created the difference. In cases where the normality assumption was met, the Independent Sample T test was used to compare two independent groups. Statistical significance was defined at 0.05

Table 3. Discoloration of nanohybrid and microhybrid composite on time intervals

Groups	Solutions	$\Delta E1$	$\Delta E2$	$\Delta E3$
		Mean. $\pm$ S.D (Median)	Mean. $\pm$ S.D (Median)	Mean. $\pm$ S.D (Median)
Nanohybrid	Iron	2.92 $\pm$ 1.45 (2.70)	4.88 $\pm$ 1.85 (4.34)	2.45 $\pm$ 0.65 (2.59)
	Sambucus nigra	1.87 $\pm$ 0.63 (1.74)	3.69 $\pm$ 1.35 (3.18)	2.63 $\pm$ 1.67 (2.35)
	Resveratrol	16.02 $\pm$ 4.3 (15.17)	28.26 $\pm$ 4.93 (28.36)	12.50 $\pm$ 6.51 (9.59)
	Propolis	11.86 $\pm$ 2.7 (10.91)	21.22 $\pm$ 4.91 (20.86)	9.75 $\pm$ 4.55 (10.22)
	Distilled Water	2.12 $\pm$ 0.69 (1.86)	2.76 $\pm$ 1.20 (2.77)	3.60 $\pm$ 1.61 (3.60)
Microhybrid	Iron	2.02 $\pm$ 0.95 (1.72)	4.01 $\pm$ 2.14 (4.08)	2.42 $\pm$ 1.38 (2.38)
	Sambucus nigra	2.35 $\pm$ 0.84 (2.62)	4.51 $\pm$ 0.62 (4.61)	3.30 $\pm$ 1.34 (3.13)
	Resveratrol	14.13 $\pm$ 4.81 (14.57)	25.06 $\pm$ 4.76 (23.91)	11.34 $\pm$ 4.38 (13.37)
	Propolis	11.88 $\pm$ 3.34 (11.9)	26.82 $\pm$ 5.44 (25.74)	15.23 $\pm$ 7.28 (15.57)
	Distilled Water	2.68 $\pm$ 1.34 (3.28)	2.67 $\pm$ 1.12 (2.33)	3.51 $\pm$ 1.64 (3.55)

$$\Delta E1 = T_1 - T_0, \Delta E2 = T_2 - T_0, \Delta E3 = T_2 - T_1$$

Table 4. Comparison of discoloration measurements by solution and time for groups

		Type 3 Sum of Squares	df	Mean Square	F**	p
Nanohybrid	Time	845.170	1.237	683.081	54.571	<0.001*
	Time*Solution	894.224	4.949	180.682	14.435	<0.001*
	Error (Time)	542.066	43.305	12.517		
Microhybrid	Time	880.426	1.223	720.154	46.380	<0.001*
	Time*Solution	984.253	4.890	201.270	12.962	<0.001*
	Error (Time)	664.404	42.789	15.527		

F: analysis of variance test statistics. *p<0,05 and **Greenhouse-Geisser test statistics

Table 5. Comparison of coloration measurements by groups for measurement times and solutions

Solutions		ΔE1	ΔE2	ΔE3
Iron	Test	1.461	0.868	0.056
	Statistics			
	P	0.166	0.400	0.957
Sambucus nigra	Test	-	-1.554	-
	Statistics	1.297		0.894
	P	0.216	0.152	0.387
Resveratrol	Test	0.829	1.323	0.420
	Statistics			
	P	0.421	0.207	0.681
Propolis	Test	-	-2.163	-
	Statistics	0.016		1.806
	P	0.988	0.048*	0.092
Distilled Water	Test	-	0.162	0.106
	Statistics	1.058		
	P	0.314	0.874	0.917

*Statistically significant association (p < 0.05)

RESULTS

Descriptive statistics as mean, standard deviation and median for groups were given in Table 3. In nanohybrid composites, the highest color change difference between baseline and Day 7 (ΔE2) was observed in the resveratrol group (28.26 ± 4.93), while in microhybrid composites, it belonged to the propolis group (26.82 ± 5.44).

Two-way repeated measures ANOVA test was applied to compare the coloration measurements according to group, solution and time. As a result of the analysis, a statistically significant difference was found between the coloration measurements according to time in nanohybrid and microhybrid groups (p<0.05). In addition, it was observed that the interaction effect of time and solution was significant (p<0.05) (Table 4).

In the nanohybrid group, a statistically significant difference was determined between ΔE2 and ΔE3 according to Bonferroni tests for iron (p=0.027). According

to Bonferroni tests for resveratrol and propolis solution, statistically significant differences were observed between ΔE2 with ΔE1 and ΔE3 (p<0.001 and p<0.001). No statistically significant differences were obtained between the coloration measurements according to time in Sambucus nigra and distilled water (p>0.05).

In the microhybrid group, statistically significant differences were observed between ΔE2 with ΔE1 and ΔE3 according to Bonferroni tests for resveratrol and propolis (p<0.001 and p<0.001). No statistically significant differences were obtained between the coloration measurements according to time in iron, Sambucus nigra and distilled water (p>0.05).

After 7 day of immersion in different pediatric multivitamins and mineral supplements composite specimens shown in Figure 2. In the images obtained with the stereo microscope, the staining and surface roughness of both nanohybrid and microhybrid composites are remarkable, and it has been observed that propolis and resveratrol cause a surface change that is even noticeable to the eye.

Independent Sample T tests were applied for the comparison of coloration measurements according to the groups for measurement times and solutions. As a result of the analysis, a statistically significant difference was found between the ΔE2 time and coloration measurements in propolis solution according to the groups Microhybrid-propolis group measurement is higher than Nanohybrid-propolis group measurement. (p<0.05). There is no statistically significant difference between the color change of microhybrid composites and nanohybrid composites for other solutions (p>0.05) (Table 5).

The color changes of the groups for 3 different time intervals according to composite types and solution differences are shown in the Figure 3.

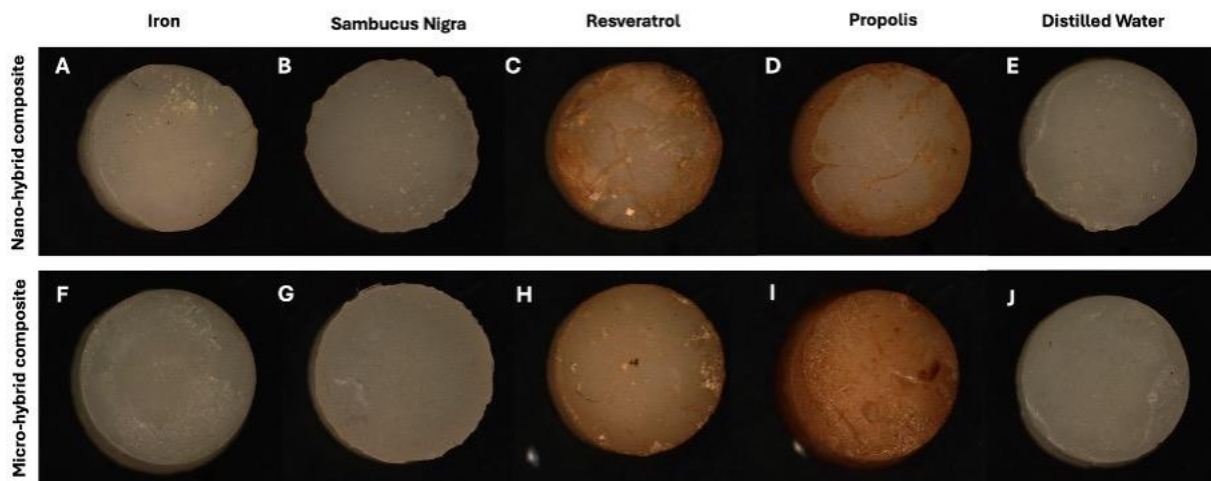


Figure 2. Nanohybrid and microhybrid composites after seven day immersion in pediatric multivitamin syrups

DISCUSSION

Prolonged or chronic use of over-the-counter multivitamins for children may present challenges by increasing plaque acidity, leading to dental caries and dental erosion. In addition to all these, long-term use of drugs and multivitamins may cause discoloration of

for the material. Much more visit to the dentist creates a more unpleasant situation for children with dental anxiety (9–11). Resin composites can experience discoloration due to a combination of extrinsic factors, as well as interactions between the resin-matrix filler particles, particle-matrix boundaries, and resin monomer absorption. The size of the filler particles and the concept of fillers also impact the surface roughness of resin composites. A higher proportion of fillers and a lower amount of monomers result in reduced water absorption due to the high hydrophilicity exhibited by the monomers (19). Microhybrid resin composites, a traditional type, are recognized for their superior mechanical, optical, and physical characteristics. The smoothness or roughness of these materials influences their optical properties, susceptibility to discoloration, water absorption rates, and plaque build-up potential (22). Nanohybrid resin composites are widely preferred due to their ability to enhance filler distribution within the matrix through a combination of nanoparticles and submicron particles, resulting in improved mechanical, chemical, and optical characteristics (23).

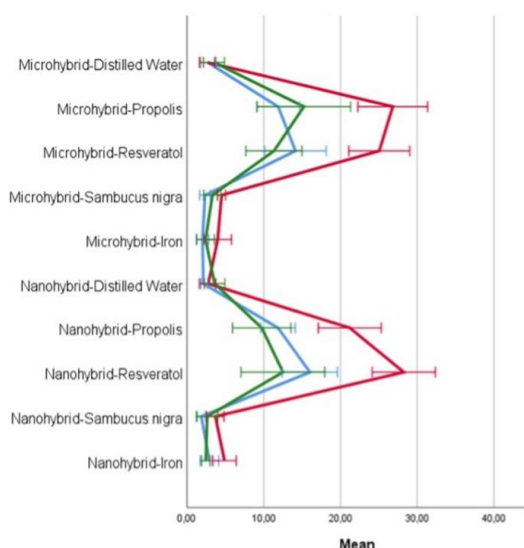


Figure 3. Line graph of the distribution of color change for all groups

restorative materials used in pediatric dentistry. The discoloration of resin composite restorations can lead to a reduction in aesthetic properties and necessitate additional expenses for restoration renewal. Also, a rough surface can lead to increased wear and a shorter lifespan

Color changes are affected by the thickness and surface properties of the restorative material. The thickness of the composite discs prepared using standard molds was ensured to be the same in each sample. After the composite was placed, the remaining part was stripped and all samples were subjected to the same polishing procedure. Also, time kept in solution is another criterion for discoloration of restorative material. Ertürk-Avunduk et al. explained in their study that keeping the samples in solutions for 12 hours in an *in-vitro* environment is equivalent to 1 year in the *in-vivo* environment (intake of 2

times per day) (24). Considering that multivitamins are used much longer and more regularly than other pediatric drugs, the holding times in the solution have been determined for this study.

There are many different methods used in studies for discoloration measurement. Previous studies have shown that employing spectrophotometry and colorimetry techniques to measure quantitative color changes using CIE L^*a^*b offers several benefits, including repeatability, sensitivity, and objectivity. Thus, in this study, spectrophotometry was utilized to calculate ΔE^* values for each pediatric multivitamin and mineral supplement. Some studies evaluating the effect of pediatric drugs on the color stability of restorative materials are available in the literature. The effect of pediatric drugs such as antibiotics, analgesics, antiepileptics, bronchodilators, anxiolytics, and sympathomimetics on the color of restorative materials has been investigated (12). Especially antibiotics and analgesics are used for short-term symptomatic treatment in pediatric patients. There is no study in the literature evaluating the effect of only multivitamins and mineral supplements with different ingredients on the surface roughness and color change of restorative materials.

Multivitamin products are sold over the counter and have very different active ingredients. One of the hypothesis of this study which is pediatric multivitamin and supplement type would affect the color stability and surface roughness of resin-based restorative materials was accepted. Of the 4 different multivitamins used, especially those containing resveratrol and propolis caused visible and aesthetically unacceptable discoloration. The iron and Sambucus nigra contents of the multivitamins caused a clinically noticeable discoloration above 3.5 in the composite materials, but were more tolerable.

In their study, Doğu Kaya et al. evaluated the effect of one effervescent multivitamin (Redoxon Triple Action, Bayer, Germany) on the surface roughness and color stability of five different microhybrid composites (Pergamon, Dentac, Turkey; Estelite Posterior, Tokuyama, Japan; Geanial Anterior, GC, Japan; Charisma Opal, Kulzer, Germany; Beautifil II, Shofu, USA). Unlike our study, a product containing zinc, vitamin C and vitamin D in effervescent form was used, not a multivitamin in syrup form. In the study, only clinically noticeable color change was found in the group using Beautifil II composite ($\Delta E: 3.98 \pm 49$), and no noticeable color change was observed in other composite types (18). Under consideration, multivitamins

in effervescent tablet form can cause less coloration than those in syrup form.

Tüzüner et al. investigated the effect of different pediatric drugs on the color change of composite resin, polyacid-modified composite resin and glass ionomer cement. In the study, composite resin (Nova Compo-B Plus, Imicryl Dental, Konya, Turkey) kept in iron syrup (Ferre Sanol® B, Adeka, Turkey) for 1 week, the color changes ΔE value they obtained was 6.55 ± 1.38 (12), that is much higher than our findings (nanohybrid-iron: 4.88 ± 1.85 microhybrid-iron: 4.01 ± 2.14).

Valera et al. investigated the effect of different pediatric drugs on the microhardness and color values of resin-modified glass ionomer, compomer and composite materials. The color change of the nanohybrid composite (Filtek Z350, 3M ESPE, Germany) kept in multivitamin syrup (Zincovit, Apex Laboratory, India) after 7 days was $\Delta E : 4.37 \pm 0.34$. (17) In their study, Jamal et al. examined the color change and surface roughness of nanocomposite, resin modified glass ionomer and compomer due to different pediatric drugs. The data show that a color change value of $\Delta E : 3.99 \pm 1.09$ was obtained after the nanocomposite samples (Filtek Z350, 3M ESPE, Germany) were kept in multivitamin syrup (Calvitalis, Gulf Pharmaceutical Industries, UAE) for 1 day (16). In another study conducted by Şirinoğlu-Çapan and Birant, the effect of different pediatric drugs on the color change of composite, alcasite and high viscosity glass ionomer materials was evaluated. The color change value of microhybrid composite (Dentsply Spectrum, Dentsply DeTrey, Germany) kept in multivitamin syrup (Argivit, Hekim İlaç Medika Cosmetics, Turkey) for 7 days was $\Delta E : 2,88 \pm 2,61$. In the study of Almutairi et al. samples prepared from compomer, composite and glass ionomer cement were kept in different pediatric drugs for 2 weeks. At the end of 7 days, the color change of nanohybrid composite (Tetric N-Ceram, Ivoclar Vivadent, Liechtenstein) samples kept in multivitamin syrup (Sanovit, AUD Pharma, Egypt) was $\Delta E : 1,03 \pm 0,48$ was obtained (14).

As has been noticed, multivitamins have very different contents and active ingredients, so the potential to change the color of restorative materials also varies. Since this is the first study comparing the effects of only different multivitamins with various active ingredients on the properties of restorative materials, we believe that our findings will contribute to the literature.

The second hypothesis of this study was nanohybrid composites are more resistant to color changes more than

microhybrid ones was partially rejected. It was shown that the filler size of the composite material had no effect on the color changes caused by other multivitamins except for the propolis group. Only for the propolis group, samples made of microhybrid composite showed higher color change than samples made of nanohybrid composite.

Çelik et al. investigated the effect of syrups containing propolis extract and *Morus nigra* on the discoloration of nanohybrid, microfilled and microhybrid composites. Differently from our study, color measurements were performed according to the CIEDE2000 system, not according to the CIE L^*a^*b system. The color measurements were performed at baseline, at the end of Day 1 and Day 2. The value obtained at the end of the 1st day was $\Delta E_{00}: 1,24 \pm 0,65$ for the Nanohybrid-propolis group and $\Delta E_{00}: 4,24 \pm 0,65$ for the Microhybrid-propolis group. A statistically significant correlation was between the filler content of composite materials and the degree of discoloration was not found, similar to our study outcomes (25).

CONCLUSION

The color and surface properties of composite materials are more affected by multivitamins and mineral supplements with certain ingredients. Long-term use of resveratrol and propolis based multivitamins changes the color and surface of restorative materials to an aesthetically unacceptable degree. There is no significant difference obtained between the degree of coloration of nanohybrid and microhybrid composites. Pediatricians, pedodontics, and parents should be informed that especially propolis and resveratrol might change the color of resin-based composite materials.

Acknowledgments

The author confirms that there is no financial arrangement with anyone.

Authorship contributions

A.A. and S.A. conceived the idea, A.A. collected and analyzed the data, A.A., S.A. and Ö.Ö. led the writing and revised the manuscript and A.A., S.A. and Ö.Ö. gave final approval of the version to be published and agreed to be accountable for all aspects of the study.

Data availability statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Declaration of competing interest

The authors declares no conflict of interest.

Ethics

Not applicable.

Funding

This research received no external funding.

REFERENCES

1. Bhandari N, Bahl R, Taneja S. Effect of micronutrient supplementation on linear growth of children. *Br J Nutr.* 2001;85(S2):S131.
2. Rerksuppaphol S, Rerksuppaphol L. Effect of zinc plus multivitamin supplementation on growth in school children. *Pediatr Int.* 2016;58(11):1193–9.
3. Braakhuis A. Evidence on the health benefits of supplemental propolis. *Nutrients.* 2019;11(11).
4. Lozoff B. Iron deficiency and child development. *Food Nutr Bull.* 2007;28(4 SUPPL.):560–71.
5. Falkingham M, Abdelhamid A, Curtis P, Fairweather-Tait S, Dye L, Hooper L. The effects of oral iron supplementation on cognition in older children and adults: A systematic review and meta-analysis. *Nutr J.* 2010;9(1):1–16.
6. Harnett J, Oakes K, Carè J, Leach M, Brown D, Cramer H, et al. The effects of *Sambucus nigra* berry on acute respiratory viral infections: A rapid review of clinical studies. *Adv Integr Med.* 2020;7(4):240–6.
7. Inchingolo AD, Inchingolo AM, Malcangi G, Avantario P, Azzollini D, Buongiorno S, et al. Effects of Resveratrol, Curcumin and Quercetin Supplementation on Bone Metabolism—A Systematic Review. Vol. 14, *Nutrients.* 2022.
8. Martini L, Pecoraro L, Salvottini C, Piacentini G, Atkinson R, Pietrobelli A. Appropriate and inappropriate vitamin supplementation in children. *J Nutr Sci.* 2020;9:1–8.
9. Montes A. pH changes in dental plaque after using sugar-free pediatric medicine. *J Clin Pediatr Dent.* 2001;25(4).
10. Costa CC, Almeida ICS, Costa Filho LC. Erosive effect of an antihistamine-containing syrup on primary enamel and its reduction by fluoride dentifrice. *Int J Paediatr Dent.* 2006;16(3):174–80.
11. Maguire A, Baqir W, Nunn JH. Are sugars-free medicines more erosive than sugars-containing medicines? An in vitro study of paediatric medicines with prolonged oral clearance used regularly and long-term by children. *Int J Paediatr Dent.* 2007;17(4):231–8.
12. Tüzüner T, Turgut S, Baygin O, Yilmaz N, Tuna EB, Ozen B. Effects of Different Pediatric Drugs on the Color Stability of Various Restorative Materials Applicable in Pediatric Dentistry. *Biomed Res Int.* 2017;2017.

13. Faghihi T, Heidarzadeh Z, Jafari K, Farhoudi I, Hekmatfar S. An experimental study on the effect of four pediatric drug types on color stability in different tooth-colored restorative materials. *Dent Res J (Isfahan)*. 2021;18(1):1–6.
14. Almutairi M, Moussa I, Alsaeri N, Alqahtani A, Alsulaiman S, Alhajri M. The Effects of Different Pediatric Drugs and Brushing on the Color Stability of Esthetic Restorative Materials Used in Pediatric Dentistry: An In Vitro Study. *Children*. 2022;9(7):5–8.
15. Çapan BŞ, Birant S. Effect of pediatric drugs on the color stability of dental restorative materials currently used in pediatric dentistry. *J Aust Ceram Soc [Internet]*. 2024;(0123456789). Available from: <https://doi.org/10.1007/s41779-024-00991-2>
16. Jamal DY, Farsi NM, El-Housseiny AA, Felemban OM. Effects of pediatric liquid medications on surface properties of dental restorations. *Med Sci*. 2022;26(120):1.
17. Valera B, Bhatt R, Patel M, Patel C, Makwani D, Goyal S. Effect of different pediatric medications on various tooth colored restorative materials used in pediatric dentistry. *Int J Health Sci (Qassim)*. 2022;6(March):508–21.
18. Doğu Kaya B, Yılmaz Atalı P, Özmen S, Öztürk S, Tarçın B. Effect of an Effervescent Multivitamin on Color and Surface Roughness of Micro-Hybrid Dental Resin Composites. *Materials (Basel)*. 2024;17(5).
19. Nasim I, Neelakantan P, Sujeer R, Subbarao C V. Color stability of microfilled, microhybrid and nanocomposite resins - An in vitro study. *J Dent [Internet]*. 2010;38(SUPPL. 2):e137–42. Available from: <http://dx.doi.org/10.1016/j.jdent.2010.05.020>
20. Lehmann KM, Devigus A, Igiel C, Weyhrauch M, Schmidtmann I, Wentaschek S, et al. Are dental color measuring devices CIE compliant? *Eur J Esthet Dent*. 2012;7(3):324–33.
21. Paravina RD, Pérez MM, Ghinea R. Acceptability and perceptibility thresholds in dentistry: A comprehensive review of clinical and research applications. *J Esthet Restor Dent*. 2019;31(2):103–12.
22. Zhou ZR, Zheng J. Tribology of dental materials: A review. *J Phys D Appl Phys*. 2008;41(11).
23. Hong G, Yang J, Jin X, Wu T, Dai S, Xie H, et al. Mechanical properties of nanohybrid resin composites containing various mass fractions of modified zirconia particles. *Int J Nanomedicine*. 2020;15:9891–907.
24. Erturk-Avunduk AST, Aksu S, Delikan E. The Effects of Mouthwashes on the Color Stability of Resin-Based Restorative Materials. *Odovtos - Int J Dent Sci*. 2021;23(1):91–102.
25. Çelik ZC, Elbek Çubukçu Ç, Batmaz SG. Exploring the discoloration potential of Propolis extract and Morus nigra syrup on restorative dental composites: an in vitro study. *J Heal Sci Med*. 2023;6(2):289–93.