https://doi.org/10.14368/jdras.2025.41.2.132 Original Article
ISSN 2384-4353 eISSN 2384-4272

Effect of traditional Korean fermented foods on the color stability of single-shade resin

Heejae Kwon[1], Myoung Uk Jin[1,2]*
[1]Department of Conservative Dentistry, School of Dentistry, Kyungpook National University, Daegu, Republic of Korea
[2]Advanced Dental Device Development Institute, Kyungpook National University, Daegu, Republic of Korea

Purpose: This study was to evaluate the effect of coffee and traditional Korean fermented foods on the color stability of single-shade resin compared to resin composites with a multi-shade system. **Materials and Methods:** Two esthetic composite resins were used: one nanofilled (FiltekTM Z350 XT universal A2 shade, 3M ESPE) and one supra-nanofilled (Omnichroma, single shade, Tokuyama Dental). A silicone mold (8 mm diameter, 2 mm thickness) was used to create the composite resin specimens. The resin was applied to the mold, covered with a mylar strip, and light-cured with an LED photopolymerizer (VALO Grand, Ultradent) for 40 seconds. All specimens were polished per manufacturer instructions and stored in distilled water at 37°C for 24 hours. Baseline color measurements were taken using a spectrophotometer (Minolta CM-26d, Minolta Co.,) following the CIE Lab* system. Afterward, the specimens were divided into four groups (red pepper paste, soy sauce, coffee, and distilled water), and color changes (ΔE) were measured at 1, 7, and 14 days. Independent samples t-test was used to determine if there was a difference in color change between composite resins. Kruskal-Wallis test was used to determine if there was a difference between solutions. **Results:** On Day 1, only the coffee group showed a significant color difference between the two resins, with Omnichroma exhibiting more color change. By Day 7, the soy sauce group also showed significant color differences in both Omnichroma and Filtek Z350 XT ($P < 0.05$), with color change increasing in all groups. Similar to Day 1, Omnichroma had greater color changes overall. On Day 14, there was a color difference between the two resins in the coffee and soy sauce groups, similar to Day 7. While the red pepper paste and distilled water groups showed more color change in Omnichroma, the differences were not statistically significant. **Conclusion:** Within the limitations of this study, when tested with coffee and traditional Korean fermented foods, Filtek Z350 XT demonstrated greater color stability compared to Omnichroma. Additionally, coffee caused more discoloration in the resin than the traditional Korean fermented foods. **(J Dent Rehabil Appl Sci 2025;41(2):132-9)**

Key words: composite resin; discoloration; esthetic; dental restoration; colorimetry

Introduction

While there are many resin products on the market, new products are being developed all the time, and the latest trends in resin products are color matching and long-lasting color stability. In clinical practice, the top reasons for removing and restoring existing resin restorations are color mismatch and discoloration of existing restorations.[1]

More recently, resins have been developed with a "structural color" technology that allows them to represent all of a patient's colors (A1 through D4) in one shade. These "structural color" technologies do not use any pigments at all but instead represent col-

*Correspondence to: Myoung-Uk Jin
Professor, Department of Conservative Dentistry, School of Dentistry, Advanced Dental Device Development Institute, Kyungpook National University, 2177 Dalgubuldaero, Jung-gu, Daegu, 41940, Republic of Korea
Tel: +82-53-600-7623, Fax: +82-53-426-8958, E-mail: musljin@knu.ac.kr
Received: May 5, 2025/Last Revision: May 9, 2025/Accepted: May 13, 2025

Copyright© 2025 The Korean Academy of Stomatognathic Function and Occlusion.
©It is identical to Creative Commons Non-Commercial License.

ors based solely on the physical properties of light. Various terms are used to describe the phenomenon of expressing the color surrounding the tooth, and according to ISO standards, the term "color shifting" is used to describe this phenomenon. However, "color adjustment" has become the most commonly used term.[2]

Among the resins with this technology, a resin called "Omnichroma (Tokuyama Dental, Tokyo, Japan)" has been proven to have superior performance, and its use can reduce the color difference between the restoration and the tooth, simplify the process of resin restoration, and improve the color-matching ability of restoration.[3] Previous studies have shown that color stability varies depending on the resin material tested, and "omnichroma" has the smallest color change among commercially available composite resins with "color adjustment" ability.[4]

While numerous studies have explored the color harmony of single-shade resin composites, research on their color stability remains relatively scarce. In addition, previous studies have shown that when color change was measured after resin specimens were immersed in coffee, specimens immersed in coffee showed a huge color change.[5] Also, in a study measuring the color change of artificial teeth, red pepper paste showed more color change than other immersion solutions.[6] Finally, soy sauce has also been proven to cause discoloration in resin restorations.[7] No previous paper has studied the discoloration of a single-shade resin with traditional Korean fermented foods.

This study aimed to evaluate the effect of traditional Korean fermented foods on the color stability of single-shade resin compared to resin composites with a multishade system.

Materials and Methods

Specimen preparation

This study was conducted as outlined in Fig. 1. Two esthetic composite resins were used. One nano-filled (FiltekTM Z350 XT universal A2 shade, 3M ESPE, St Paul, USA) and one supra-nanofilled (Omnichroma, single shade, Tokuyama Dental) composite resins were used. The composite resins used in this study are described in Table 1.

A mold of 8 mm diameter and 2 mm thickness was made from silicone to fabricate the composite

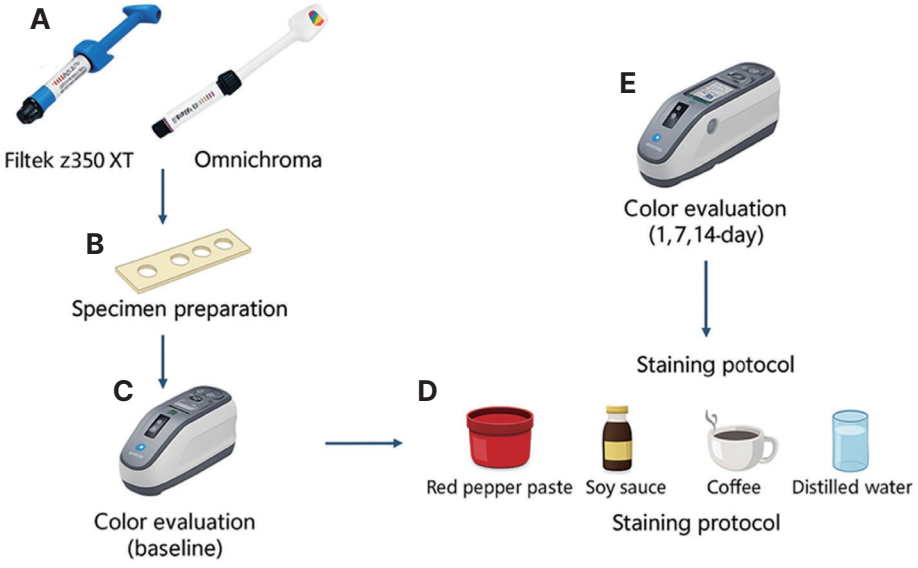

Fig. 1. Experimental design flowchart. (A) Composite resins used,(B) Specimens were placed in silicone molds and polymerized using an LED light-curing unit, (C) Baseline color measurements were performed using a spectrophotometer, (D) Specimens were immersed daily in staining solutions, (E) Color measurements were conducted after 1, 7, and 14 days.

Table 1. Composite resins used in this study

Resin	Manufacturer	Type	Matrix	Filler	Filler size (μm)	Filler content (wt%/vol%)
Filtek™ Z350 XT universal (A2B)	3M ESPE, St Paul, MN, USA	Nanofilled	Bis-GMA, UDMA, TEGDMA, PDGDMA, Bis-EMA	Nonaggregated silica/ zirconia filler Aggregated silica/ zirconia cluster	Silica 0.02/ Zirconia 0.004 - 0.011	78.5/63.3
Omnichroma (Single Shade)	Tokuyama Dental, Shibuya, Tokyo, Japan	Supra-nano filled	TEGDMA, UDMA	Supra- nano spherical filler (SiO_2, ZrO_2)	0.26	79/68

Bis-GMA: Bisphenol A-Glycidyl Methacrylate; UDMA: Urethane Dimethacrylate; TEGDMA: Triethylene Glycol Dimethacrylate; PDGDMA: Poly(dodecylglycol) Dimethacrylate; Bis-EMA: Ethoxylated Bisphenol A Dimethacrylate.

resin specimens. Then, using a resin instrument, the composite resin was applied to the vortex of the mold, and a mylar strip was applied on top of it. Photopolymerization was performed using an LED photopolymerizer (VALO Grand, Ultradent, South Jordan, USA) for 40 s. All specimens were then polished using the ENHANCE, POGO polishing system according to the manufacturer's instructions. All specimens were stored in distilled water at 37-degrees for 24 hours.

Color measurements

Baseline color measurements were made before the specimens were precipitated in solution. Color measurements were performed according to the CIE (Commission Internationale de L'Eclairage) L*a*b* system using a spectrophotometer (Minolta CM-26d, Minolta Co., Osaka, Japan). According to the CIE L*a*b* system, color is represented by three values: first, the L value means lightness from black (0) to white (100), then a value means red (+) to green (-), and finally the b value means yellow (+) to green (-).

Before measuring each specimen's color, the spectrophotometer was calibrated using black and white plates according to the manufacturer's instructions. All specimens were then rinsed with distilled water for 5 seconds and blot-dried with Kimwipes (Kimtech Science). Measurements were repeated three times at all locations and averaged.

After the baseline color measurement, the specimens were divided into four groups: red pepper paste, soy sauce, coffee and distilled water. Red pepper paste was prepared as a paste by adding 10 cc of distilled water to 90 g of red pepper paste, and 80 cc of soy sauce was used in its original form. Coffee was made by mixing 12 g of coffee with 70 cc of distilled water. The solutions used in this study are described in Table 2.

Color measurements were taken every 1, 7, and 14

Table 2. Solution used in this study

Materials	Commercial name	Manufacturer
Red pepper paste	Taeyangcho	Haechandle, Korea
Soy sauce	Sampio Jin	Sampio foods co., Korea
Coffee	Maxim mocha gold mild	Dong Suh food co., Ltd., Korea
Distilled water	Sterile water for injection	Daihan Pharm co., Ltd., Korea

days, and the color change (ΔE) was calculated using the following equation. A single operator performed all experimental procedures.

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

Statistical analysis

The Shapiro-Wilk test was used to test for normal distribution and the Levene test was used to test for the equality of variances. Independent samples t-test was used to determine if there was a difference in color change between composite resins. Kruskal-Wallis test was used to determine if there was a difference between solutions (SPSS v25.0; SPSS, Inc., Chicago, USA).

Results

Significant color differences between Omnichroma and Filtek Z350 XT resin were present on days 1, 7, and 14 in the COFFEE group, and on days 7 and 14 in the soy sauce group ($P < 0.05$). In the remaining red pepper paste and distilled water groups, there were no significant differences between Omnichroma and Filtek Z350 XT resin colors.

First, on day 1, the results are shown in Table 3. Only the coffee group had a significant color difference between the two groups, with significantly more color change in the Omnichroma group. In the other material groups, there was no significant difference between the groups, although Omnichroma resin showed more color change.

Next, on day 7, the soy sauce group also showed significant color differences in Omnichroma ($P < 0.05$), and the amount of color change increased in all groups (Table 3). Similar to day 1, all color changes were greater in the Omnichroma group.

On day 14, there was a color difference between the two resin groups in the coffee and soy sauce groups, the same as on day 7 (Table 3). The red pepper paste and distilled water groups also showed more color change in the Omnichroma, but there was no significant difference between the groups.

Over time, color change increased in all groups. By tinting group, coffee showed the most significant amount of color change at all time points, and soy sauce generally showed more considerable color change than red pepper paste. Still, red pepper paste showed more color change in the Filtek Z350 XT resin on day 14.

Discussion

Advances in nanotechnology have allowed simpler

Table 3. Color changes (ΔE) of resin composites after 1, 7, and 14 days (Mean ± SD)

Day	Solution	Filtek Z350 XT (Mean ± SD)	Omnichroma (Mean ± SD)	*P*
1	Red pepper paste	2.34 ± 1.19^{Aa}	2.58 ± 1.00^{Aa}	0.3161
	Soy sauce	2.68 ± 1.80^{Ba}	3.28 ± 1.64^{Ba}	0.2222
	Coffee	12.31 ± 2.58^{Ca}	14.55 ± 2.98^{Cb}	< 0.05*
	Distilled water	0.91 ± 0.42^{Da}	2.32 ± 3.48^{Da}	0.1620
7	Red pepper paste	3.71 ± 1.15^{Aa}	4.22 ± 1.60^{Aa}	0.2120
	Soy sauce	4.27 ± 1.24^{Ba}	7.16 ± 2.70^{Bb}	< 0.05*
	Coffee	16.32 ± 3.37^{Ca}	20.17 ± 3.73^{Cb}	< 0.05*
	Distilled water	2.07 ± 1.29^{Da}	3.18 ± 2.52^{Da}	0.3075
14	Red pepper paste	4.69 ± 1.27^{Aa}	5.52 ± 2.13^{Aa}	0.1511
	Soy sauce	3.72 ± 0.93^{Ba}	5.92 ± 1.96^{Bb}	< 0.05*
	Coffee	17.43 ± 4.20^{Ca}	20.58 ± 2.84^{Cb}	< 0.05*
	Distilled water	2.11 ± 0.76^{Da}	2.12 ± 0.02^{Da}	0.7913

Different lowercase superscript letters indicate statistically significant differences between composite resins ($P < 0.05$). Different uppercase superscript letters indicate statistically significant differences between immersion solutions within the same composite resin ($P < 0.05$).

restorative methods to repair areas that previously required complex layering techniques.[8] The new single-color resin allows Omnichroma to represent colors from VITA classic A1-D4 in one shade, which is achieved by reflecting specific wavelengths of light, such as those corresponding to tooth color.[9,10] In this study, one of these new-generation resins, called Omnichroma, was compared to Filtek Z350 XT–a resin with a more traditional color system–to evaluate color changes after immersion in traditional Korean fermented foods, thereby assessing how these common dietary components may influence resin discoloration.

Similar to previous studies, this study used spectrophotometry and the CIE Lab* color system for color measurement, which are recommended methods in dental research due to their sensitivity, reproducibility, and objectivity.[11] Spectrophotometers are particularly advantageous because, unlike colorimeters, they are not affected by metamerism.[12] The CIE Lab* system uses L, a, and b values to calculate the ΔE value, a standard indicator of color change.[13] Perceptibility and acceptability thresholds help determine whether a color change is noticeable or clinically acceptable. In this study, a ΔE value between 1 and 3 was considered perceptible to the naked eye, while a value greater than 3.3 was deemed clinically unacceptable.[14] On day 1, red pepper paste and soy sauce produced clinically acceptable values, but coffee exceeded the 3.3 threshold. By days 7 and 14, all groups except the distilled water control exhibited ΔE values exceeding 3.3, highlighting the need for further investigation into the staining potential of these substances.

Various factors can cause discoloration of resin, which can be broadly categorized into exogenous and endogenous causes.[15] Endogenous discoloration is due to chemical changes within the material, often related to the chemical bonds between the resin matrix and filler particles.[16] Exogenous discoloration results from the absorption of staining agents from the environment, such as those introduced through diet, oral hygiene practices, or smoking.[17] Thus, the aesthetic and mechanical stability of a resin restoration is influenced not only by the material's internal structure but also by external environmental factors, prompting consideration of dietary and lifestyle factors in the evaluation of resin performance.

We used three experimental groups in this experiment: red pepper paste, soy sauce, and coffee. Coffee was selected as a known staining agent, as previous studies have consistently shown its strong coloring effect on composite resins.[18] Red pepper paste and soy sauce were chosen due to the lack of prior studies evaluating their impact on single-shade resins, despite Jeon et al.'s findings that these fermented foods significantly discolor denture base resins.[19] Distilled water served as the control group, as it is considered to mimic the effects of saliva on composite resin behavior, making it a suitable baseline for comparison with staining agents.[20]

The coffee-immersed group showed greater color changes than the others, exceeding clinically acceptable thresholds as early as day 1. This is attributed to the low-polarity yellow pigments in coffee, which are capable of penetrating the deeper layers of composite resin.[21] The red pepper paste and soy sauce groups exhibited clinically unacceptable levels of discoloration on days 7 and 14, though not on day 1, suggesting that the discoloration was time-dependent and linked to the progressive penetration of staining pigments.

The color change in distilled water was clinically acceptable in all groups. On day 1, the Filtek Z350 XT group had the smallest change, which showed a imperceptible change to the naked eye. Previous results indicated an unacceptable level of color change after immersing composite resin in distilled water for 5 days.[21] Also, previous studies have shown that water absorption in composite resins reaches its highest levels between 7 and 60 days.[22] In this experiment, Filtek Z350 XT showed the highest color change on day 14 when immersed in distilled water, while Omnichroma exhibited the highest change on day 7.

Overall, Omnichroma showed greater color change than Filtek Z350 XT, likely due to differences in their resin matrices. Filtek Z350 XT is formulated with high molecular weight monomers like BisEMA and BisGMA. BisEMA is hydrophobic and has low water absorption due to its high degree of conversion,[23] while BisGMA contributes to higher cross-

linking density.[24] In contrast, Omnichroma contains lower molecular weight monomers like UDMA and TEGDMA. TEGDMA is hydrophilic and known to increase water absorption, which impairs color stability.[23] Increased water uptake enlarges the free volume within the polymer matrix, allowing more water molecules to penetrate. This leads to accelerated polymer degradation and more pronounced discoloration, which may explain the observed performance differences between the two resins.[25]

It is important to note that the experimental conditions in this study differ from real-world clinical scenarios. Long-term and constant exposure to substances like coffee, soy sauce, and red pepper paste is unlikely in actual practice. While this is a limitation, it underscores the importance of simulating real-world conditions in future research to better understand resin behavior over time.

Nevertheless, the findings of this study provide essential foundational data for predicting potential color changes caused by various foods in clinical settings. Future research should incorporate more realistic simulations of the oral environment to better evaluate the long-term color stability of resin composites. Thus, the results of this study can serve as a reference for ensuring color stability in clinical practice and contribute to more informed resin selection and management.

Conclusion

Within the limitations of this in vitro study, the findings indicate that the color stability of composite resins is influenced by the type of food and resin system. Filtek Z350 XT, a multi-shade nanofilled resin, exhibited superior color stability compared to the single-shade Omnichroma resin, especially when exposed to coffee and traditional Korean fermented foods such as soy sauce and red pepper paste. Among the staining agents, coffee resulted in the greatest color change, highlighting its strong discoloration potential. These results suggest that when esthetic longevity is a clinical priority, especially in dietary environments where such staining foods are common, multi-shade composite systems like Filtek Z350 XT may be more favorable.

ORCID

Heejae Kwon https://orcid.org/0009-0009-5567-3310
Myoung-Uk Jin https://orcid.org/0000-0001-9263-047X

References

1. Eltahlah D, Lynch CD, Chadwick BL, Blum IR, Wilson NH. An update on the reasons for placement and replacement of direct restorations. J Dent 2018;72:1-7.
2. Ismail EH, Paravina RD. Color adjustment potential of resin composites: Optical illusion or physical reality, a comprehensive overview. J Esthet Restor Dent 2022;34:42-54.
3. Saegusa M, Kurokawa H, Takahashi N, Takamizawa T, Ishii R, Shiratsuchi K, Miyazaki M. Evaluation of Color-matching Ability of a Structural Colored Resin Composite. Oper Dent 2021;46:306-15.
4. Sensi L, Winkler C, Geraldeli S. Accelerated Aging Effects on Color Stability of Potentially Color Adjusting Resin-based Composites. Oper Dent 2021; 46:188-96.
5. Rohym S, Tawfeek HEM, Kamh R. Effect of coffee on color stability and surface roughness of newly introduced single shade resin composite materials. BMC Oral Health 2023;23:236.
6. Lee YI, Cho IH, Lee JS. The effect of various foods on the color stability of artificial teeth. J Korean Acad Prosthodont 2009;47:82-90.
7. Chan KC, Fuller JL, Hormati AA. The ability of foods to stain two composite resins. J Prosthet Dent 1980;43:542-5.
8. La Rosa GRM, Pasquale S, Pedullà E, Palermo F, Rapisarda E, Gueli AM. Colorimetric study about the stratification's effect on color perception of resin composites. Odontology 2020;108:479-85.
9. de Abreu JLB, Sampaio CS, Benalcázar Jalkh EB, Hirata R. Analysis of the color matching of universal resin composites in anterior restorations. J Esthet Restor Dent 2021;33:269-76.
10. Durand LB, Ruiz-López J, Perez BG, Ionescu AM, Carrillo-Pérez F, Ghinea R, Pérez MM. Color, light-

ness, chroma, hue, and translucency adjustment potential of resin composites using CIEDE2000 color difference formula. J Esthet Restor Dent 2021;33: 836-43.
11. Brook AH, Smith RN, Lath DJ. The clinical measurement of tooth color and stain. Int Dent J 2007; 57:324-30.
12. Chu SJ, Trushkowsky RD, Paravina RD. Dental color matching instruments and systems. Review of clinical and research aspects. J Dent 2010;38 Suppl 2:e2-16.
13. Sharma G, Wu W, Dalal EN. The CIEDE2000 color-difference formula: implementation notes, supplementary test data, and mathematical observations. Color Res Appl 2005;30:21-30.
14. Lee YK, Powers JM. Discoloration of dental resin composites after immersion in a series of organic and chemical solutions. J Biomed Mater Res B Appl Biomater 2005;73:361-7.
15. Nasim I, Neelakantan P, Sujeer R, Subbarao CV. Color stability of microfilled, microhybrid and nanocomposite resins - an in vitro study. J Dent 2010;38 Suppl 2:e137-42.
16. Souza AB, Silame FD, Alandia-Roman CC, Cruvinel DR, Garcia Lda F, Pires-de-Souza Fde C. Color stability of repaired composite submitted to accelerated artificial aging. Gen Dent 2012;60:e321-5.
17. Janda R, Roulet JF, Kaminsky M, Steffin G, Latta M. Color stability of resin matrix restorative materials as a function of the method of light activation. Eur J Oral Sci 2004;112:280-5.
18. Gross MD, Moser JB. A colorimetric study of coffee and tea staining of four composite resins. J Oral Rehabil 1977;4:311-22.
19. Jeon YM, Lim HS, Shin SY. The effect of fermented foods on the color and hardness change of denture base acrylic resins. J Korean Acad Prosthodont 2004;42:344-55.
20. Bétrisey E, Bella ED, Krejci I, Ardu S. Influence of Storage Media on Color Stability of Diferent Resin Composites as Determined by ΔE and ΔE00. Dent Adv Res 2018;3:151.
21. Hussain SK, Al-Abbasi SW, Refaat MM, Hussain AM. The effect of staining and bleaching on the color of two different types of composite restoration. J Clin Exp Dent 2021;13:e1233-8.
22. Bilmez ZY, Şeker O, Köse HD, Aslan BG. Evaluation of liquid sorption and color stability of dental composites after exposure to common lactation teas. Int Dent Res 2021;11 Suppl 1:228-33.
23. Gajewski VES, Pfeifer CS, Fróes-Salgado NRG, Boaro LCC, Braga RR. Monomers used in resin composites: Degree of conversion, mechanical properties, and water sorption/solubility. Braz Dent J 2012;23:508-14.
24. Elliott JE, Lovell LG, Bowman CN. Primary cyclization in the polymerization of bis-GMa and TEGDMA: a modeling approach to understanding the cure of dental resins. Dent Mater 2001;17:221-9.
25. Ferracane JL. Hygroscopic and hydrolytic effects in dental polymer networks. Dent Mater 2006;22:211-22.

전통 한국 발효 음식이 단일 색상 레진의 색 안정성에 미치는 영향

권희재[1] 전공의, **진명욱**[1,2*] 교수

[1]경북대학교 치과대학 치과보존학교실

[2]경북대학교 첨단치과의료기기개발연구소

목적: 본 연구는 커피와 한국 전통 발효 식품이 단일 색상 레진의 색 안정성에 미치는 영향을 다중 색조 레진 복합 레진과 비교하여 평가하였다.

연구 재료 및 방법: 두 가지 심미용 복합레진이 사용되었다. 하나는 nanofilled resin (Filtek™ Z350 XT universal A2 shade)이고, 다른 하나는 spura-nanofilled 단일 색상 레진(Omnichroma, single shade)이다. 실리콘 몰드(직경 8 mm, 두께 2 mm)를 사용하여 복합레진 시편을 제작하였다. 레진을 몰드에 도포하고 mylar strip으로 덮은 후, LED 광중합기(VALO Grand, Ultradent)를 사용하여 40초 동안 광중합하였다. 모든 시편은 제조사의 지침에 따라 연마한 뒤, 37°C의 증류수에 24시간 보관하였다. 초기 색상 측정은 CIE Lab* 시스템에 따라 분광광도계(Minolta CM-26d, Minolta Co.)를 사용하여 수행하였다. 이후, 시편을 네 그룹(고추장, 간장, 커피, 증류수)으로 나누어 1일, 7일, 14일째에 색상 변화(ΔE)를 측정하였다. 복합 레진 간 색상 변화의 차이를 확인하기 위해 독립 표본 t-검정을 사용하였다. 용액 간 색상 변화의 차이를 확인하기 위해 Kruskal-Wallis 검정을 사용하였다.

결과: 1일차에는 커피 그룹에서만 두 레진 간에 유의미한 색상 차이가 나타났으며, Omnichroma에서 색상 변화가 더 크게 나타났다($P < 0.05$). 7일차에는 간장 그룹에서도 Omnichroma와 Filtek Z350 XT 모두에서 유의미한 색상 차이가 관찰되었고($P < 0.05$), 모든 그룹에서 색상 변화가 증가하였다. 1일차와 유사하게, Omnichroma는 전반적으로 더 큰 색상 변화를 나타냈다. 14일차에는 커피와 간장 그룹에서 두 레진 간에 7일차와 유사한 색상 차이가 나타났다. 고추장과 증류수 그룹에서는 Omnichroma에서 색상 변화가 더 많았지만, 유의미한 차이는 없었다.

결론: 본 연구의 한계 내에서, 커피와 한국 전통 발효 식품을 함께 시험했을 때, Filtek Z350 XT는 Omnichroma에 비해 더 우수한 색 안정성을 보였다. 또한, 커피는 한국 전통 발효 식품보다 레진에서 더 많은 변색을 유발하였다.

(구강회복응용과학지 2025;41(2):132-9)

주요어: 복합 레진; 변색; 심미적 특성; 치과 수복물; 색차 측정

*교신저자: 진명욱

(41940)대구광역시 중구 달구벌대로 2177 경북대학교 치과대학 치과보존학교실

Tel: 053-600-7623 | Fax: 053-426-8958 | E-mail: musljin@knu.ac.kr

접수일: 2025년 5월 5일 | 수정일: 2025년 5월 9일 | 채택일: 2025년 5월 13일