

# Comparative Evaluation Of Colour Stability Of Two Resin Based Restorative Materials: An In Vitro Study

Author

---

## Abstract

**Introduction:** The colour stability of resin-based restorative materials basically depends on the type of resin material used. Different solutions such as medicinal syrups, fruit juices and colas can significantly affect colour stability. Moreover, restorative material discolouration might be attributed to the degree of water sorption and matrix resin hydrophilicity. While restorative materials have been tested in the past, adhesive and new resin-based restorative materials require further investigation regarding their discolouration properties. The purpose of this study was to test and compare the effect of different storage solutions on the colour stability of two different resin-based restorative materials. It is reported that the matrix, filler composition and content, minor pigment addition, initiation components and filler coupling agents also affect the colour of aesthetic materials. Hence, aesthetically, for a better selection of the restorative material, colour stability needs to be evaluated.

**Aim:** The aim of the study was to evaluate and compare the colour stability of two resin-based restorative materials.

**Materials and Methodology:** Thirty samples were prepared for each restorative material to compare colour stability and were divided into three subgroups based on the solution used. The restorative materials used in this study were Group A, BEAUTIFIL II GIOMER SHOFU INC, and Group B, Wizdent WONDER BULKFILL. Specimens of each group were fabricated using a steel mould of dimensions 5 mm × 5 mm × 2.5 mm. Specimens were gently removed from the mould, immersed in distilled water for 24 hours at 37°C, then removed and air-dried. The colour parameters of specimens were measured with a colorimeter before storage. Specimens of both groups were placed in respective solutions, i.e., medicinal syrup, fruit juice, and cola, for 4 weeks. The solutions were renewed weekly. After 4 weeks, the specimens were removed from the solutions, rinsed, and tested using a colorimeter.

**Results:** The study results indicated that the overall total colour difference observed was greater in specimens stored in cola and lesser in specimens stored in medicinal syrup. The total colour difference was observed to be greater in giomer compared to bulk-fill composite when specimens were stored in medicinal syrup. The total colour difference was observed to be almost similar for both groups when specimens were stored in fruit juice and cola. Overall, the total colour difference observed was lesser for the bulk-fill composite restorative material.

**Conclusion:** Current resin-based restorative materials are prone to discoloration over time when exposed to various storage solutions. Resin-based restorations may darken, particularly with frequent consumption of darker beverages such as cola.

**Citation:** Dhamal S, Katge F, Bhanushali P. Comparative Evaluation of Colour Stability of Two Resin Based Restorative Materials: An in Vitro Study.

**Keywords:** BEAUTIFIL II GIOMER SHOFU INC, Cola, Colorimeter, Colour stability, Discolouration, Fruit juice, Medicine syrup, Wizdent WONDER BULKFILL.

---

Date of Submission: 02-12-2025

Date of Acceptance: 12-12-2025

---

## I. Introduction

The colour stability of resin-based restorative materials largely depends on the type of resin material used. Different solutions, such as medicinal syrups, fruit juices, and colas, can significantly affect colour stability. Moreover, restorative material discolouration may be attributed to the degree of water sorption and the hydrophilicity of the matrix resin.

While restorative materials have been tested in the past, adhesive and new resin-based restorative materials require further investigation regarding their discolouration properties. The purpose of this study was to test and compare the effects of different storage solutions on the colour stability of two different resin-based restorative materials.

Resin-based restorative materials are a class of composites used for direct or indirect repair, consisting of a polymerizable resin matrix and inorganic filler or fibre as reinforcement. They are typically formulated with methacrylate monomers, initiators, and fillers and are cured through radical polymerization, resulting in

hard materials. Resin-based restorative materials are often preferred, especially in cases with high aesthetic requirements. They consist of organic matrices, fillers, initiators, inhibitors, and plasticizers. Composite resin restorative materials were developed to overcome the disadvantages of amalgam restorative materials.<sup>2-3</sup>

The two resin-based restorative materials used were:

- **Giomer** (BEAUTIFIL II GIOMER, SHOFU INC.): A versatile, fluoride-releasing, nanohybrid direct aesthetic restorative material that contains modified S-PRG fillers, designed for a variety of anterior and posterior restorations. It shows remarkable wear resistance, radiopacity three times that of natural dentin for accurate diagnosis, fluorescence similar to natural teeth, and excellent biocompatibility.
- **Bulk-fill composite** (Wizdent WONDER BULKFILL): A restorative material with innovative advanced filler technology. Its superior filler load allows for steady light transmission, resulting in a greater depth of cure, better shade matching, and high resistance to wear. Wonder Bulk Fill's symmetric refractive fillers help mimic the shade of adjacent teeth, ensuring a better shade match compared with other available bulk-fill composites, which often exhibit a greyish or overly translucent appearance.<sup>4-5</sup>

It has been reported that matrix composition, filler content and type, minor pigment additions, initiator components, and filler coupling agents also affect the colour of aesthetic materials.<sup>6</sup> Despite their widespread acceptance in meeting aesthetic demands, previous studies have revealed that resin-based restorative materials are susceptible to various degrees of discolouration, which may be attributed to intrinsic or extrinsic factors. Intrinsic factors involve alterations or changes in the chemical structure of resin-based restorative materials under physical and chemical conditions, while extrinsic factors are mainly due to surface staining from absorption or adsorption of exogenous substances.<sup>7</sup> Hence, for better aesthetic outcomes and appropriate selection of restorative materials, colour stability needs to be thoroughly evaluated.

## II. Material & Methodology:

The current in vitro study was conducted in the Department of Paediatric and Preventive Dentistry from December 2024 to January 2025. The study design was approved by the International Ethical Review Board Committee.

Table 1: Two resin base restorative materials used in the study:

Two resin based restorative materials used in the study			
Materials	Type	Composition	Manufacturer
BEAUTIFIL II GIOMER SHOFU INC	Giomer	Fluoride, Strontium, Sodium, Aluminum, Silicate and Borate	SHOFU Dental Corporation, 1225 Stone Drive San Marcos CA 92078-4059, USA
Wizdent WONDER BULKFILL	Bulk-fill composite	Barium glass, ytterbium trifluoride, mixed oxide, proacrylate, and zirconium or silica particles.	Pidilite Industries Limited, United Kingdom

Two resin-based restorative materials, differing in their composition and indications, were tested in this study (Table 1). A total of 30 samples were prepared for each restorative material and divided into three subgroups based on the solution used. Group A (Giomer) was divided as follows: 10 samples stored in medicine syrup, 10 samples stored in fruit juice, and 10 samples stored in cola. Group B (Bulk-fill composite) was divided similarly: 10 samples stored in medicine syrup, 10 samples stored in fruit juice, and 10 samples stored in cola. Based on the result of previous studies sample size calculation was done. A total of 60 samples were prepared; 30 for Group A (Giomer) and 30 for Group B (Bulk-fill composite).



Figure 1: The two-resin based restorative materials used for the study for which colour stability is to be compared

Group A: BEAUTIFIL II GIOMER SHOFU INC  
Group B: Wizdent WONDER BULKFILL



Figure 2: Three commonly consumed liquids by childrens

Specimens of each group were fabricated using a steel mould with dimensions of 5 mm × 5 mm × 2.5 mm. The specimens were gently removed from the mould, immersed in distilled water for 24 hours at 37 °C, then removed and air-dried. The specimens were air-dried and tested three times on a white background under daylight illumination to obtain a baseline colorimetric measurement. Before testing, the colorimeter was calibrated with a specified calibration plate.<sup>8-10</sup> The CIE-Lab colour system, defined as a three-dimensional (3D) measurement system, was applied, where 'L' indicates brightness, 'a' represents the red-green axis, and 'b' represents the yellow-blue axis.<sup>11</sup>

Two resin-based restorative materials (n=10) were immersed in three storage solutions for four weeks. All specimens were stored in plastic containers containing the storage solutions, kept in an air-tight, dark environment at 37 °C. The solutions were renewed weekly.

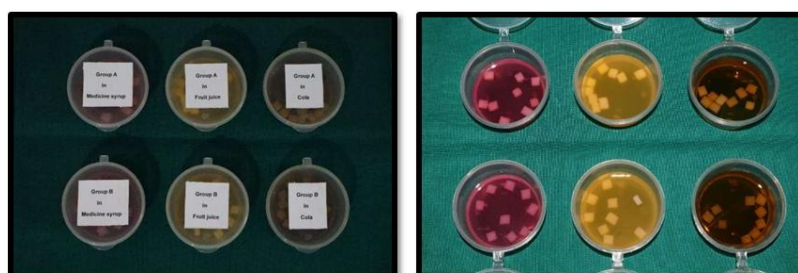


Figure 3 and 4: Prepared specimens stored in solutions

After four weeks, the specimens were removed from the solution, rinsed, dried oil-free, and tested colorimetrically as described previously. Specific colour coordinate differences – brightness ( $\Delta L$ ), red-green ( $\Delta a$ ) chroma and yellow-blue ( $\Delta b$ ) chroma – were calculated between the baseline and the fourth week values. The total colour difference ( $\Delta E$ ) was calculated using the formula:  $(\Delta E) = [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2}$  and was automatically stored digitally by a computer connected to the colorimeter.<sup>12</sup>



Figure 5: Specimens tested using colorimeter

## Statistical Analysis:

Data analysis was conducted using IBM SPSS Statistics software, version 25. The data obtained were tabulated and analysed using a two-way ANOVA test and a probability value of  $\leq 0.05$  was considered significant.

### III. Results:

The mean colour change values and standard deviations of the two resin-based restorative materials are depicted in Table 2. The study results indicated that the overall total colour difference observed was greater in specimens stored in cola and lesser in specimens stored in medicine syrup. The total colour difference was observed to be greater in giomer as compared to bulk-fill composite when specimens were stored in medicine syrup. The total colour difference was observed to be almost similar for both groups when specimens were stored in fruit juice and cola. Overall, the total colour difference observed was less for the bulk-fill composite restorative material.

Table 2: Descriptive Statistics [Dependent variable ( $\Delta E$ )]

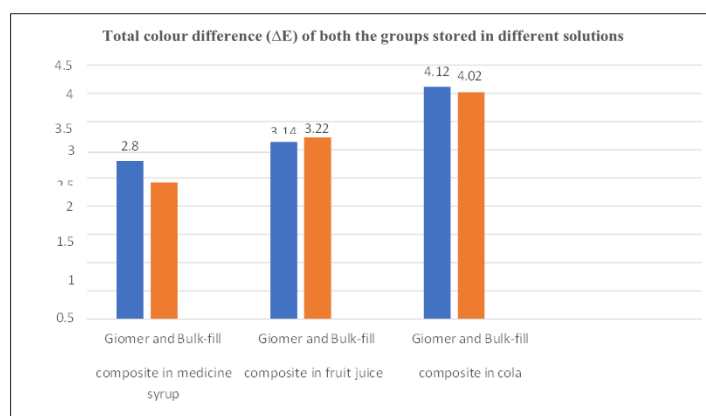
Solution	Material	Mean	Std. Deviation	N
Medicine syrup	Giomer	2.8000	0.04163	10
	Bulk-fill	2.4200	0.02667	10
	Total	2.6100	0.19788	20
Fruit juice	Giomer	3.1400	0.02906	10
	Bulk-fill	3.2180	0.02098	10
	Total	3.1790	0.04701	20
Cola	Giomer	4.1220	0.03521	10
	Bulk-fill	4.0160	0.01838	10
	Total	4.0690	0.06086	20
Total	Giomer	3.3540	0.57114	30
	Bulk-fill	3.2180	0.66305	30
	Total	3.2860	0.61736	60

Based on the observed means, multiple comparison values with a 95% confidence interval are depicted in Table 3.

Table 3: Multiple comparison [Dependent variable ( $\Delta E$ )]

	Solution (I)	Solution (J)	Mean difference	Std. Error	Significant difference	95% Confidence interval	
						Lower boundary	Upper boundary
Bonferroni	Medicine syrup	Fruit juice	-0.5690*	0.00940	0.000	-0.5922	-0.5458
		Cola	-1.4590*	0.00940	0.000	-1.4822	-1.4358
	Fruit juice	Medicine syrup	0.5690*	0.00940	0.000	0.5458	0.5922
		Cola	-0.8900*	0.00940	0.000	-0.9132	-0.8668
	Cola	Medicine syrup	1.4590*	0.00940	0.000	1.4358	1.4822
		Fruit juice	0.8900*	0.00940	0.000	0.8668	0.9132

Based on the observed means, the error term is Mean Square (Error) = 0.001 and the mean difference is significant at the 0.05 level.

Figure 6: Total colour difference ( $\Delta E$ ) of both the groups stored in different solutions

#### **IV. Discussion:**

The present study compared the colour stability of two commercially available resin- based restorative materials: Giomer and Bulk-fill composite. The colour stability of resin-based restorative materials primarily depends on the type of resin material used. Different solutions, such as medicinal syrups, fruit juices, and colas, can significantly affect colour stability.

In a study by Pani SC et al., while restorative materials have been tested in the past, adhesive and new resin-based restorative materials require further investigation regarding their discoloration behaviour. The purpose of this study was to test and compare the effects of different storage solutions on the colour stability of two different resin-based restorative materials.<sup>13-14</sup>

In study by Malekipour et al., colour change values were calculated before and after 1, 7 and 14 days of immersion, while in our study colour change values were calculated before and after 4 weeks only.<sup>15</sup> Another study done by Fares et al., in which samples are immersed in oral rinse solution and tested by reflective spectrophotometer, while in our study samples are stored in commonly consumed liquids by children and then tested by colorimeter.<sup>16</sup>

Due to the constant presence of oral microflora, saliva, and the frequent intake of food, the colour stability of aesthetic materials may be hampered. The present study compared the colour stability of two resin-based restorative materials in different commonly consumed liquids by children, i.e., medicinal syrup, fruit juice, and cola.<sup>17</sup>

The established CIE Lab system, one of the most common colour measurement systems in dentistry, was used in this study, providing precise results for several colour parameters. Different storage solutions affect the colour of different resin-based restorative materials.<sup>18-19</sup>

Consistent with literature reports, no resin-based restorative material group showed any perceptible discoloration.<sup>20</sup> The immersion time in this study was set at four weeks, as this time interval has been regularly used in colourimetric studies in the past. These studies reflect the long-term effects of several storage solutions without considering clinical influences such as oral hygiene.<sup>21</sup>

Our study results show that the overall total colour difference observed was greater in specimens stored in cola and less in specimens stored in medicinal syrup, which is similar to the findings of Falkensammer et al. According Umand Ruyte et al., Cola had lowest pH and it might damage surface integrity of composite resin materials. It is noteworthy that materials which contained TEGDMA showed higher discoloration values meaning TEGDMA was responsible for discoloration due to hydrophilic character.<sup>22-23</sup> In clinical practices patients should be aware of staining effects of drinks tested in this study, while practitioners should take into consideration the staining susceptibility of resin based restorative materials.

The total colour difference was greater in Giomer compared to Bulk-fill composite when specimens were stored in medicinal syrup. The total colour difference was observed to be almost similar for both groups when specimens were stored in fruit juice and cola.<sup>24-25</sup> Overall, the total colour difference observed was less for the Bulk- fill composite restorative material. Therefore, based on our study results, it is clear that Bulk-fill composite restorative material is also a good option for the restoration of both posterior and anterior teeth.<sup>26</sup>

#### **Limitations:**

- One of the limitations of the present study is the in vitro methodology, which only simulates intraoral conditions to some extent and focuses on the individual discoloration effects of each solution.
- The use of the colorimeter for colour measurement also has limitations due to edge loss error, which results in interference between the illuminant and the colour sensor.

#### **V. Conclusion:**

Based on the present findings, the following conclusions were drawn:

- Current resin-based restorative materials are prone to discoloration over time when exposed to various storage solutions.
- In current study, maximum amount of colour changes in both resin-based restorative materials are shown by cola followed by fruit juice and medicine syrup.
- Resin-based restorations may darken, particularly with frequent consumption of darker beverages such as cola.
- Additionally, bulk-fill composites present's a viable option for restorative treatments in paediatric patients, offering both efficiency and aesthetic benefits.

### References:

- [1]. Falkensammer F, Arnetzl Gv, Wildburger A, Freudenthaler J. Color Stability Of Different Composite Resin Materials. J Prosthet Dent. 2013;109(6):378-83.
- [2]. Pratap B, Gupta Rk, Bhardwaj B, Nag M. Resin Based Restorative Dental Materials: Characteristics And Future Perspectives. Jpn Dent Sci Rev. 2019;55(1):126-38.
- [3]. Jandt Kd, Sigusch Bw. Future Perspectives Of Resin-Based Dental Materials. Dent Mater. 2009;25(8):1001-6.
- [4]. Rusnac Me, Gasparik C, Irimie Ai, Grecu Ag, Mesaros As, Dudea D. Gionomers In Dentistry - At The Boundary Between Dental Composites And Glass-Ionomers. Med Pharm Rep. 2019;92(2):123-28.
- [5]. Van Ende A, De Munck J, Lise Dp, Van Meerbeek B. Bulk-Fill Composites: A Review Of The Current Literature. J Adhes Dent. 2017;19(2):95-109.
- [6]. Hotwani K, Thosar N, Baliga S. Comparative In Vitro Assessment Of Colour Stability Of Hybrid Esthetic Restorative Materials Against Various Children's Beverages. J Conserv Dent. 2014;17(1):70-74.
- [7]. Lee Yk, Yu B, Lee Sh, Cho Ms, Lee Cy, Lim Hn. Shade Compatibility Of Esthetic Restorative Materials-A Review. Dent Mater. 2010;26(12):1119-26.
- [8]. Buchalla W, Attin T, Hilgers Rd, Hellwig E. The Effect Of Water Storage And Light Exposure On The Color And Translucency Of A Hybrid And A Microfilled Composite. J Prosthet Dent 2002;87:264-70.
- [9]. Gaintantzopoulou M, Kakaboura A, Vou Giouklakis G. Colour Stability Of Tooth- Co Loured Restorative Materials. Eur J Prosthodont Restor Dent 2005;13:51-6.
- [10]. Nathanson D, Banasr F. Color Stability Of Resin Cements - An In Vitro Study. Pract Proced Aesthet Dent 2002;14:449-55.
- [11]. Johnston Wm. Color Measurement In Dentistry. J Dent 2009;37:2-6.
- [12]. Chu Sj, Trushkowsky Rd, Paravina Rd. Dental Color Matching Instruments And Systems. Review Of Clinical And Research Aspects. J Dent. 2010;38(2):2-16.
- [13]. Katge F, Shitoot A, Pammi T, Mithiborwala S. Evaluation Of Microleakage Of Nanoionomer And Nanocomposite Restorations, Immersed In Fruit Drink, Fresh Fruit Juice And Soft Drink--An In Vitro Study. J Clin Pediatr Dent. 2016;40(2):129-35.
- [14]. Fulgoni VI Quann Ee. National Trends In Beverage Consumption In Children From Birth To 5 Years: Analysis Of Nhanes Across Three Decades. Nutr J 2012; 11:92.
- [15]. Malekipour Mr, Sharafi A, Kazemi S, Khazaei S, Shirani F. Comparison Of Color Stability Of A Composite Resin In Different Color Media. Dent Res J (Isfahan). 2012;9(4):441-6.
- [16]. Fares Hm. Color Stability Of Different Resin Composites Under Moisture And Chemical Stimulants And Changes. Advanced Dental Journal 2023;5(1) 59 – 66.
- [17]. Guler Au, Yilmaz F, Kulunk T, Guler E, Kurt S. Effects Of Different Drinks On Stainability Of Resin Composite Provisional Restorative Materials. J Prosthet Dent. 2005;94(2):118-24.
- [18]. Maganur Pc, Prabhakar Ar, Sugandhan S, Namineni S. Evaluation Of Microleakage Of Rmgic And Flowable Composite Immersed In Soft Drink And Fresh Fruit Juice: An In Vitro Study. Int J Clin Pediatr Dent 2010;3(3):153-61.
- [19]. Yilmaz Mn, Gul P. Susceptibility To Discoloration Of Dental Restorative Materials Containing Dimethacrylate Resin After Bleaching. Odontology. 2023;111(2):376- 86.
- [20]. Hariprasath Tk, Balaji Ganesh S, Devi Rg. Colour Stability Of Composite Resins - A Review. Indian Journal Of Forensic Medicine & Toxicology 2020;14(4):4539-42.
- [21]. Iqbal S, Kalyan Ss, Gupta Rk, Lone P, Koul M. Evaluation Of Color Stability Of Different Esthetic Restorative Materials With Whitening Dentifrices. Journal Of Indian Association Of Public Health Dentistry 2024;22(1):112-15.
- [22]. Tekce N, Tuncer S, Demirci M, Serim Me, Baydemir C. The Effect Of Different Drinks On The Color Stability Of Different Restorative Materials After One Month. Restor Dent Endod. 2015;40(4):255-61.
- [23]. Khatri A, Nandlal B. Staining Of A Conventional And A Nanofilled Composite Resin Exposed In Vitro To Liquid Ingested By Children. Int J Clin Pediatr Dent. 2010;3(3):183-8.
- [24]. Muhittin U, Burak Tu, Kam Ho. Color Stability Of Microhybrid And Nanofilled Composite Resins: Effect Of Surface Sealant Agents Containing Different Filler Content. J Contemp Dent Pract. 2019;20(9):1045-50.
- [25]. Erdemir U, Yildiz E, Eren Mm. Effects Of Sports Drinks On Color Stability Of Nanofilled And Microhybrid Composites After Long-Term Immersion. J Dent. 2012;40(2):55-63.
- [26]. Yazici Ar, Celik C, Dayangaç B, Özgünaltay G. The Effect Of Curing Units And Staining Solutions On The Color Stability Of Resin Composites. Oper Dent. 2007;32(6):616-22.