RESEARCH PAPER

EFFECT OF LIQUID AND SOLID MULTIVITAMIN PREPARATIONS ON THE COLOUR STABILITY OF GLASS IONOMER CEMENT: AN IN VITRO INVESTIGATION

Type of study: *Original research*

Running title: *Multivitamin effect on the colour stability of GIC.*

N. Vishal Prakasam[1], Balaji Ganesh S.[2*]

[1]Undergraduate, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-600 077, India | Email: 152001025.sdc@saveetha.com

[2*]Reader, Department of Periodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India | Email: balajiganeshs.sdc@saveetha.com

Corresponding author: Dr. Balaji Ganesh S. | Reader, Department of Periodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, 162, PH Road, Chennai 600077, Tamil Nadu, India | Contact Number: 8220713554 | Email: balajiganeshs.sdc@saveetha.com

ABSTRACT

Background

Most of the population consumes multivitamins due to vitamin deficiency and its consequences as a part of medications which could affect the dental restoration colour stability such as GIC. The study aims to find the effect of multivitamins which most vitamin deficient patients consume and its effect on colour stability of GIC.

Materials and method

GIC pellets were made using moulds of the same dimensions which were later immersed into multivitamin drugs using t test.

Results

There is significant change in the colour of the GIC from the values calculated from the exposure with multivitamins. The delta E value for the tablet was higher which shows the multivitamin tablet form is less colour stable than the syrup.

Conclusion

Colour stability of GIC showed significant variations with the time dependent exposure to multivitamins. The colour stability with tablets is less as compared to the multivitamin syrup.

Keywords: Colour stability, Discolouration, GIC, Multivitamins.

How to cite this article: Vishal Prakasam N, Balaji Ganesh S. Effect of Liquid and Solid Multivitamin Preparations on the Colour Stability of Glass Ionomer Cement: An In Vitro Investigation. Int J Drug Deliv Technol. 2026;16(54s): 1456-1460. DOI: 10.25258/ijddt.16.54s.131

Source of support: Nil.

Conflict of interest: None.

INTRODUCTION

The importance of aesthetic restorative materials is highly increasing in the field of dentistry among different age groups(1). Esthetics have a greater impact in this era of social media(2). Dental treatment involves the restorative materials such as Glass ionomer cement(GIC)(3), composites(4) and compomers which are commonly taken into consideration according to the patient's requirements. The colour of dental materials can change when subjected to various physical and chemical agents or with the age(5).

Glass ionomer cements come under the category of restorative materials involving acid base reactions(6). The reaction involves the product formation from weak polymeric acids with powdered glasses(7,8). The final structure involves unreacted glass in order to act as filler for reinforcing the setting of cement(9,10). Because of its high fluoride release and the chemical bonding to teeth it is considered as a choice for many luting and restorative functions(11).

Many intrinsic and extrinsic factors are involved in colour instability of the dental materials which are being analysed for a long period of time(12)which can be explained by the absorption and adsorption mechanisms(13)(14). The variations shown between filler components of the resin material is regarded as the intrinsic effect Nevertheless, ideal composite resin formulations are being researched that allow for optimal aesthetic results(15).

The evaluation of staining and discoloration has frequently used tools like using spectrometers, digital cameras or the colorimeter(13). Values of colour were

reported using the CIE *delta E*, which allowed for the testing of the colour change's intensity using three coordinates(16). The accurate determination of the degree of colour difference between objects is made possible by numerical descriptions of colour(17,18). If there is a variation in colour, it shows if a human observer can notice a change in overall shade(19).
The study analysed the colour changes of GIC restorative materials after usage of multivitamin syrup and tablet for 1 week.

MATERIALS AND METHOD

Preparation of the sample

For each drug, n = 20 specimens (diameter of 1 mm and height of 3 mm) were prepared using moulds were prepared according to the manufacturers' instructions. The completed samples were taken out from the moulds and smooth surfaces were made using polishing kits, the samples were placed at 37°C for 24 h in distilled water for rehydration and for their polymerization.

Staining procedure

The samples made were immersed into the multivitamin syrup for once for 2 minutes at 37°C for around 7 days. The solutions were changed everyday. in order to stimulate the same condition as that of multivitamin syrup and tablet consumption. Between the immersion periods the specimens were placed in normal water in order to prevent dehydration and contamination.

Measurement of colour change

The specimens which were made and then subjected to immersion in multivitamin syrups and the effervescent tablets for 7 days, the pre immersive and post immersion values were noted using the Konica Minolta spectrometer CM-5.

Statistical analysis

For the analysis of the pre immersive and post immersive values analysed were later subjected to t test with confidence level of 95%

RESULTS

Table 1: The Comparison between the multivitamin syrup and the effervescent tablet on the GIC colour stability.

Groups	Multivitamin syrup	Multivitamin tablet
Mean	1.350	3.1140
SD	0.5969	1.9847
N	10	10
P value	0.0150	

P value and the statistical significance: The P value equals 0.0150. The value is considered to be statistically significant. Delta E value is inversely proportional to the colour value which means the tablets showed less colour stability with value of 3.1140 than the syrup 1.350.

DISCUSSION

Shade matching is a procedure used regularly in everyday dentistry and is essential to successful restorations(20,21). Therefore, this information should be entered in the patient record. In addition, dentists have obligations under medical law and a social responsibility to be meticulous when documenting the process(22). The amount of dental ante-mortem records used as evidence is of great importance in forensic work, and poor ante-mortem records can hinder casework in forensic dentistry(23). Records with exact and complete dates are clearly a match.

Aesthetics, which is a much required property of the restorative material, is lost with the exposure to the different agents with different pH(24) and colour (25)which is related to the food consumption(26). Authors have also shown the potential staining caused by the beverages(27), tea, and coffee(28) on the restorative materials which showed a significant relationship(29,30).
According to (31)Glass ionomer cements showed staining with the prolonged use of different herbal tea preparations and showed instability with the colour. Also colour stability of the conventional GIC(32) was less as compared to Giomer used in the paediatric dentistry(33) Therefore, the study aimed to analyse the effect of multivitamins on the stability of the colour(22,34) of the GIC which is the most commonly used restorative dental

material in routine dental practice(35). In recent advancements Green-mediated nano-enhanced GIC has shown to have less inflammation and upregulation of healing genes compared to conventional GIC, suggesting better integration in clinical outcomes(28). Incorporation of *Acacia nilotica* into GIC also showed promising potential as a restorative material.(36) The null hypothesis is used such that the agents do not change the colour stability of each material regardless of time(7,37)(7,37,38)). And the difference between materials can differ between them. The results showed that the null hypothesis was not accepted because there was a large change in material colour.

The changes in the colour were analysed using a photo spectrometer that gives a reliable method for this type of analysis because it does not allow for evaluations which are subjective and errors are avoided in the interpretation of the colour. The usage of instruments is more accurate than the direct observation and the perception of colour by the observers. The limitation of the study is that the sample size taken were less and in future extensive study on the same with larger samples can give us more analytical values.

CONCLUSION

There is significant colour change in the specimens taken with respect to the exposure to multivitamin tablets which is responsible for the colour instability and thus it can have an effect on the aesthetics and appearance of the material. As the delta E value is greater for the multivitamin tablet it showed less colour stability of the GIC whereas the multivitamin syrup group showed greater colour stability with the GIC with a low delta E value.

Acknowledgement :

The authors express their gratitude to Saveetha Dental College & Hospitals for supporting and for successful completion of this project.

Conflict of Interest :

The authors hereby declare that there is no conflict of interest in this study.

REFERENCES

1. Miletic V. Dental Composite Materials for Direct Restorations. Springer; 2017. 319 p.
2. Dental materials. Determination of colour stability [Internet]. Available from: http://dx.doi.org/10.3403/02129078u
3. Damayanti N, Kusuma IA, Dhanardhono T, Natania B. THE EFFECTS OF HIGH TEMPERATURE HEATING ON COLOUR AND WEIGHT CHANGES IN GIC AND RMGIC (A STUDY TO SUPPORT IDENTIFICATION OF FIRE VICTIMS) [Internet]. Vol. 7, Dentino : Jurnal Kedokteran Gigi. 2022. p. 192. Available from: http://dx.doi.org/10.20527/dentino.v7i2.14629
4. Sushma B, Ganesh SB, Jayalakshmi S. Effect of carbonated beverages on flexural strength of composite restorative material. J Adv Pharm Technol Res. 2022 Nov;13(Suppl 1):S160–3.
5. Drakul D. Physical and Chemical Properties of Dental Restorative Materials that Affect their Clinical Efficiency. Trans Tech Publications Ltd; 2020. 84 p.
6. Somani R, Jaidka S, Singh D, Shafat S. Comparative evaluation of compressive strength, diametral tensile strength and shear bond strength of GIC type IX, chlorhexidine-incorporated GIC and triclosan-incorporated GIC: An in vitro study [Internet]. Vol. 6, Journal of International Society of Preventive and Community Dentistry. 2016. p. 64. Available from: http://dx.doi.org/10.4103/2231-0762.181188
7. Gaviria J, Quijano S, Quijano J, Ruiz P. Computational study of the relative stability of some glass-ionomer cement-forming molecules. J Mol Model. 2022 Sep 28;28(10):333.
8. Tărăboanță I, Buhățel D, Nica I, Stoleriu S, Ghiorghe AC, Pancu G, et al. The Impact of Simulated Gastric Acid and Toothbrushing on Surface Characteristics of Resin-

Modified Glass-Ionomer Cements. Medicina [Internet]. 2022 Aug 24;58(9). Available from: http://dx.doi.org/10.3390/medicina58091149

9. Morales-Valenzuela AA, Scougall-Vilchis RJ, Lara-Carrillo E, Garcia-Contreras R, Hegazy-Hassan W, Toral-Rizo VH, et al. Enhancement of fluoride release in glass ionomer cements modified with titanium dioxide nanoparticles. Medicine . 2022 Nov 4;101(44):e31434.
10. Dhivyasri E, Jessy Paulraj JP, Maiti S. Comparative evaluation of fluoride-releasing properties in nano-formulated and conventional Glass Ionomer Cements: An in-vitro study. J Clin Diagn Res [Internet]. 2025 Apr 1; Available from: https://www.jcdr.net/article_fulltext.asp?issn=0973-709x&year=2025&month=April&volume=19&issue=4&page=ZC07-ZC12&id=20826
11. Pani SC, Aljammaz MT, Alrugi AM, Aljumaah AM, Alkahtani YM, AlKhuraif A. Color Stability of Glass Ionomer Cement after Reinforced with Two Different Nanoparticles. Int J Dent. 2020 May 31;2020:7808535.
12. 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 [Internet]. 2022 Jul 10;9(7). Available from: http://dx.doi.org/10.3390/children9071026
13. British Standards Institution. Method for Determination of Colour Stability of Dental Polymeric Materials. 1987. 3 p.
14. Keerthana B, Ganesh SB, Jayalakshmi S. Evaluation of flexural strength of glass ionomer cement after immersion in fruit juices. J Adv Pharm Technol Res. 2022 Nov;13(Suppl 1):S156–9.
15. Sajini SI, Mushayt AB, Almutairi TA, Abuljadayel R. Color Stability of Bioactive Restorative Materials After Immersion in Various Media. J Int Soc Prev Community Dent. 2022 Aug 29;12(4):418–25.
16. British Standards Institution. British Standard Method for Determination of Colour Stability of Dental Polymeric Materials. 1987.
17. Koumpia E, Eliades T, Knösel M, Athanasiou AE. Colour assessment of bleaching effect on orthodontically treated teeth [Internet]. Vol. 44, European Journal of Orthodontics. 2022. p. 537–47. Available from: http://dx.doi.org/10.1093/ejo/cjac006
18. Muthukumaran V, Paulraj J, Maiti S, Arunprakash R. Evaluation of Structural Characterization and Biocompatibility of Glass Ionomer Cement Enhanced with Nanocomposites of Chitosan, Titanium, Zirconium, and Hydroxyapatite: Assessment of Cell Viability and Adhesion through Gingival Fibroblast Cell Line. Int J Clin Pediatr Dent. 2025 Oct;18(10):1249–54.
19. Dimitrova M, Chuchulska B, Zlatev S, Kazakova R. Colour Stability of 3D-Printed and Prefabricated Denture Teeth after Immersion in Different Colouring Agents—An In Vitro Study [Internet]. Vol. 14, Polymers. 2022. p. 3125. Available from: http://dx.doi.org/10.3390/polym14153125
20. Council on Scientific Affairs (American Dental Association). Dental Materials-determination of Color Stability: American National Standard/American Dental Association Specification. 2001. 8 p.
21. Polak-Kowalska K, Pels E. In vitro and in vivo assessment of enamel colour stability in teeth treated with low-viscosity resin infiltration – a literature review [Internet]. Vol. 72, Journal of Stomatology. 2019. p. 135–41. Available from: http://dx.doi.org/10.5114/jos.2019.87534
22. Paravina RD, Powers JM. Esthetic Color Training in Dentistry. Mosby; 2004. 280 p.
23. Britina, Vishnu Priya V, Arthanari A, Gayathri R, Kavitha S, Reshma PK. Effect of Concentrated and Dilute Hydrochloric Acid on Tooth Morphology: A Forensic

Study [Internet]. Journal of Pharmaceutical Research International. 2022. p. 37–46. Available from: http://dx.doi.org/10.9734/jpri/2022/v34i4b35402

24. Noufal ZM, Ganesh SB, Jayalakshmi S. Effect of carbonated beverages on the color stability of bulk and flowable composite resin. J Adv Pharm Technol Res. 2022 Nov;13(Suppl 1):S144–7.
25. Mazumdar P, Chowdhury D. Manual of Laboratory Testing Methods for Dental Restorative Materials. John Wiley & Sons; 2021. 164 p.
26. Esthetics and acceptability of staining on teeth [Internet]. Vol. 65, Dental Abstracts. 2020. p. 192–3. Available from: http://dx.doi.org/10.1016/j.denabs.2019.10.035
27. Kallivayalil JG, Ganesh SB, Jayalakshmi S. Comparative analysis of effect of fruit juices on surface roughness of bulk fill and flowable composite material. J Adv Pharm Technol Res. 2022 Nov;13(Suppl 1):S136–9.
28. Ganesh S, Paulraj J, Maiti S, Mohanraj KG, Jayaraman S. Evaluating immunohistochemical and genetic expression of green-mediated nano-enhanced glass ionomer cement: An animal model study. J Conserv Dent Endod. 2025 Oct;28(10):1019–26.
29. Karakaya İ, Cengiz-Yanardag E. Effects of Staining Beverages and Office Bleaching Agents on the Optical Characteristics and Surface Topography of Maxillary Incisor Teeth [Internet]. Vol. 7, Cyprus Journal of Medical Sciences. 2022. p. 395–403. Available from: http://dx.doi.org/10.4274/cjms.2020.2726
30. Almejrad L, Yang CC, Morton D, Lin WS. The Effects of Beverages and Surface Treatments on the Color Stability of 3D-Printed Interim Restorations. J Prosthodont. 2022 Feb;31(2):165–70.
31. Haque SW, Muliya VS, Somayaji K, Pentapati KC. Effect of Different Herbal Tea Preparations on the Color Stability of Glass Ionomer Cements. CCIDE. 2021 Apr 13;13:121–5.
32. Imtiaz T, Ganesh SB, Jayalakshmi S. Surface roughness changes of two composite resin restorative materials after thermocycling. J Adv Pharm Technol Res. 2022 Dec;13(Suppl 2):S466–9.
33. Adusumilli H, Avula JSS, Kakarla P, Bandi S, Mallela GMK, Vallabhaneni K. Color stability of esthetic restorative materials used in pediatric dentistry: An in vitro study. J Indian Soc Pedod Prev Dent. 2016 Jul-Sep;34(3):233–7.
34. Viohl J. Colour Stability of Dental Resins (Abst.). 1979.
35. Ghodsi S, Aghamohseni MM, Arzani S, Rasaeipour S, Shekarian M. Cement selection criteria for different types of intracanal posts. Dent Res J . 2022 Jul 18;19:51.
36. Paulraj J, T J, S YC, Shanmugam R, Maiti S. Investigating the Potential of Acacia nilotica-Enriched Glass Ionomer Cement: An Analysis of Antimicrobial Activity and Compressive Strength. Cureus. 2024 Feb;16(2):e54821.
37. Prabhakar A, Pattanshetti K, Sugandhan S. A comparative study of color stability and fluoride release from glass ionomer cements combined with chlorhexidine. Int J Clin Pediatr Dent. 2013 Jan;6(1):26–9.
38. Alex A, Paulraj J, Maiti S, Shanmugam R. An Innovative Phyto-mediated Nanocomposite-modified Glass Ionomer Cement: A Detailed Study on Synthesis, Cytotoxicity, Anti-inflammatory Effects, Antimicrobial Activity, Mechanical Performance, and Solubility. Int J Clin Pediatr Dent. 2025 Feb;18(2):181–90.