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Research Article

A Comparative Evaluation Of Compressive Strength Of Two Universal Composite Stored In Industrial Juice For Twenty Four Hours And One Week An In Vitro Study

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ABSTRACT

Introduction:
Understanding the mechanical behavior and limitations of new single-shade universal composites when exposed to acidic oral challenges is crucial for informed clinical material selection and long-term restoration success. Aim of the present study is to evaluate and compare the compressive strength of two single-shade universal composites, Charisma Topaz ONE and OMNICHROMA, after immersion in litchi and cranberry juices for 24 hours and 1 week.

Material and Method:
Cylindrical specimens (3mm x 3mm) were fabricated from each composite (n=20/group) and randomly divided into subgroups (n=10) for immersion in deionized water (control), litchi juice, or cranberry juice. After designated immersion periods,

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specimens were subjected to compressive strength testing using a Universal Testing Machine. Data was analyzed using three-way ANOVA to evaluate effects of composite type, immersion solution, and time.

Results:

Three-way ANOVA revealed no significant differences among all groups ($p=0.111$). However, OMNICHROMA exhibited significantly lower compressive strengths compared to Charisma Topaz ONE, regardless of solution or time ($p<0.05$). For both composites, 1-week immersion significantly reduced compressive strengths vs. 24 hours in each solution ($p<0.001$).

Conclusions:

Acidic beverage immersion negatively impacted compressive strength of both universal composites over time, with OMNICHROMA displaying greater vulnerability likely due to its lower filler content. While insightful, this in vitro study has limits in extrapolating to the dynamic oral environment. Further in vivo testing is warranted.

INTRODUCTION

Resin-based composite restorations in dentistry prioritize aesthetics and physical attributes, with ongoing enhancements targeting reduced polymerization shrinkage and improved hardness. Fillers play a pivotal role, diminishing shrinkage and enhancing overall properties. Surface quality is paramount for clinical efficacy, influenced by resin matrix structure, filler traits, and particle size and shape. Improvements focus on optimizing these factors to achieve smoother surfaces, enhancing aesthetics, mechanical properties, patient comfort, and longevity of the restoration in the oral cavity.1 Various composite series incorporate spherical, irregular, and hybrid-shaped fillers, utilizing mono-, bi-, or multimodal filler formulations, resulting in distinct surface roughness due to shape variations. Acidic drinks like orange juice and cola can erode resin composites. Surface degradation of resin materials is influenced by factors such as filler volume, distribution, matrix resin composition, and the efficacy of silane surface treatment on fillers.2 The "Natural layering concept" was created to meet patients' aesthetic expectations and replicate natural teeth, yet its application typically demands advanced restorative skills and extended chairside sessions. Conversely, newly introduced single-shade universal resin composites (SsURC) streamline the restorative process, offering a simplified alternative.3 Structural color arises when a material's structure alters light wavelengths, producing vivid hues seen in nature, like those in peacocks and morpho butterflies. OMNICHROMA utilizes 260 nm spherical fillers to achieve structural color without added pigments, seamlessly blending reddish-yellow hues with natural dentition. These fillers, offering exceptional handling and strength, enable unmatched shade-matching from A1 to D4 and beyond. Powered by Tokuyama's Smart Chromatic Technology, OMNICHROMA achieves comprehensive color matching across all VITA traditional tones using a single composite shade, thanks to the precisely proportioned spherical fillers facilitating this innovative technology. Charisma Topaz ONE Shade seamlessly blends with surrounding dentition, offering a single-shade option for universal composite restorations. It absorbs lightwaves reflected by adjacent teeth to match the restoration's shade. The blend of low shrinkage stress and high flexural strength, validated in clinical studies, enhances durability. Kulzer's TCD-matrix minimizes chipping and fracturing, addressing traditional composite material limitations.5 Analyzing the microhardness of dental composites exposed to acidic beverages offers crucial insights for practitioners and researchers. The aim of this in vitro study was to compare the compressive strength of Charisma Topaz One and Omnichroma universal composite materials after immersion in ltichi and cranberry juices for 24 hours and one week.This study investigates Omnichroma and Charisma Topaz One's microhardness under such conditions, informing material selection and advancing the development of durable restoratives, thus

addressing gaps in dental knowledge. Null hypothesis for the study is there is no significant difference in compressive strength of Charisma Topaz One and OmniChroma universal composite materials after immersion in lichi and cranberry juices for 24 hours and one week.

MATERIAL AND METHOD:

The study evaluated the compressive strength of two single-shade universal composites, Charisma Topaz ONE (Kulzer GmbH, Germany) and OMNICHROMA (Tokuyama, Tokyo, Japan), after immersion in litchi and cranberry juices for 24 hours and 1 week. Twenty cylindrical specimens (3mm x 3mm) were fabricated for each composite using silicone molds. The molds were filled with composite, covered with a glass slide, and light-cured for 30 seconds from the top and bottom. The specimens were randomly divided into 4 subgroups (n=10) based on the immersion solution - litchi juice, or cranberry juice. The beverages were replaced daily to maintain their original pH. After the designated immersion periods (24 hours or 1 week), the specimens were rinsed and subjected to compressive strength testing using a Universal Testing Machine. The compressive load was applied at a crosshead speed of 1 mm/min until fracture occurred. The maximum load at fracture was recorded and the compressive strength calculated in MPa by dividing the fracture load by the cross-sectional area of the specimen. Data was analyzed using three-way ANOVA to evaluate the effects of composite type, immersion solution, and immersion time on compressive strength. Pairwise comparisons were performed using the unpaired t-test (α=0.05).

Table 1:group distribution

Group 1	Topaz one in Cranberry juice
Group 2	Topaz one in Cranberry juice
Group 3	Omnichroma in Litchi juice
Group 4	Omnichroma in Litchi juice

a

b

c

Figure 1. a) Single Shade Composite b) Silicone mould c) Juice used for Study

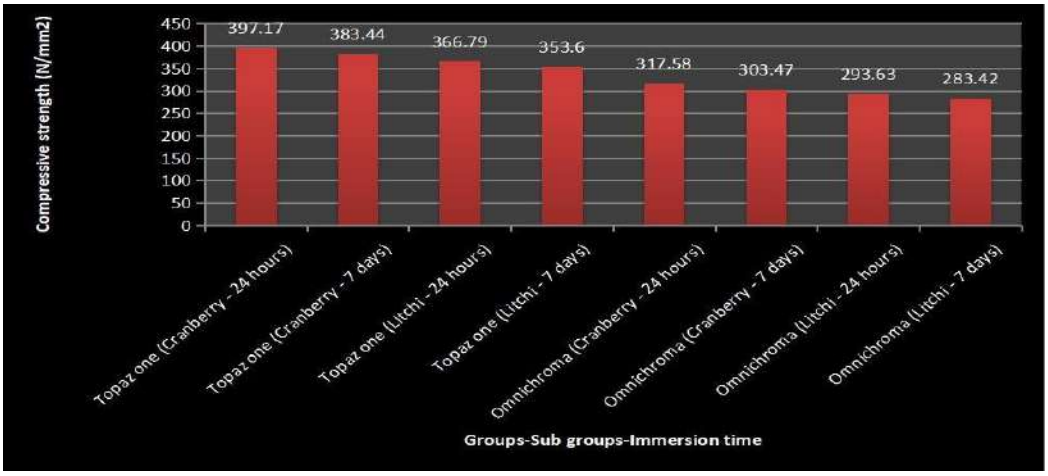
RESULT:

The mean compressive strength values and standard deviations for all experimental groups are summarized in Table 2. Three-way ANOVA revealed no significant difference in compressive strength among all groups, subgroups and immersion times (p=0.111). For the Charisma Topaz ONE composite group, two-way ANOVA showed no significant difference between the cranberry and litchi juice subgroups or the 24-hour and 1-week immersion times (p=0.705). The cranberry juice subgroup had slightly higher mean compressive strengths of 397.17 ± 1.44 MPa at 24 hours and 383.44 ± 1.69 MPa at 1 week compared to the litchi juice subgroup values of 366.79 ± 1.46 MPa and 353.60 ± 1.61 MPa respectively. In contrast, there were significant differences in compressive strength among the OMNICHROMA subgroups and immersion times (p=0.020). the cranberry juice subgroups had higher mean compressive strengths of 317.58 ± 2.01 MPa at 24 hours and 303.47 ± 1.70 MPa at 1 week compared to the litchi juice subgroups at 293.63 ± 1.54 MPa and 283.42 ± 1.42 MPa respectively. Pairwise comparisons using the unpaired t-test confirmed that for both composites, the compressive strengths at 24 hours were significantly higher than at 1 week for each juice subgroup (p<0.001). In summary, while immersion time had a significant effect on reducing compressive strength for both composites, Charisma Topaz ONE exhibited higher overall compressive strengths compared to OMNICHROMA, regardless of immersion solution or time period as shown in graph 1.

Table 2:All groups, subgroups and time wise distribution

Groups (Based on Composite)	Sub groups (Based on Juice)	Immersion Time	Compressive Strength (N/ mm^2)	
			Mean	SD
Topaz One	Cranberry	24 hours	397.17	1.44
		7 days	383.44	1.69
	Litchi	24 hours	366.79	1.46
		7 days	353.60	1.61
Omnichroma	Cranberry	24 hours	317.58	2.01
		7 days	303.47	1.70
	Litchi	24 hours	293.63	1.54
		7 days	283.42	1.42
P value = 0.111**				

Level of Significance P ≤ 0.05, * Significant, ** Non-Significant



Graph 1: All groups, subgroups and time wise distribution and compressive strength

DISCUSSION:

Resin-based restorative materials in dentistry have seen a surge due to their aesthetic appeal, evolving formulations, easy handling, and strong bonding with dental tissues. Their durability, impacted by material properties and environmental factors, is essential for sustained clinical efficacy.6 Restorative materials in the oral cavity face challenges from temperature fluctuations and exposure to acidic or alkaline substances from food and drinks. Resilience becomes crucial in withstanding such conditions, emphasizing its importance in ensuring material longevity and effectiveness.7 Omnichroma and Charisma Topaz One are single-shade universal composite restoratives known for seamlessly matching tooth shades. In a study focusing on their compressive strength after 7 days of static immersion, both showed reduced strength, with Topaz One exhibiting higher strength than Omnichroma, consistent with previous findings. The rising consumption of acidic sports and energy drinks across age groups poses a concern for dental restorations, as their low pH levels can impact longevity and durability. Erdemir et al. found that such beverages significantly reduced surface hardness compared to distilled water controls, attributed to their acidic nature, particularly the presence of citric acid. Understanding the interaction between these beverages and restorative materials is vital for clinicians to ensure optimal restoration performance and longevity.8 Nanohybrid composites exhibited a greater decrease in surface hardness compared to microhybrid composites when exposed to acidic beverages, likely due to their differing compositions.9 Filler content significantly impacts mechanical properties such as hardness, tensile strength, and fracture resistance in dental composites. Smaller filler particles reduce water absorption by the polymer network, preserving the interface matrix/filler particle integrity.10 Omnichroma composite's compressive strength declines significantly after 7 days due to chemical degradation induced by water sorption and temperature fluctuations. Water infiltration causes hydrolytic degradation and plasticization, while thermal stresses create microcracks, decreasing strength. Concerns arise regarding the material's durability in clinical conditions, impacting long-term color matching.11 Prakki et al. found that ester groups in the resin matrix undergo hydrolysis, forming extra carboxylic groups. pH influences this reaction rate, and the resulting carboxylic groups decrease pH within the polymeric matrix.12 Narsimha et al. observed that prolonged exposure to acidic media affects microhardness and marginal integrity of restorative materials. Their study established a direct correlation between acidic drink exposure duration and surface breakdown, along with marginal integrity decline in the materials.13 A limitation of the study is that in vitro microhardness decreases may not fully simulate real-world breakdown. In vivo, composites face continuous exposure to various chemicals in food and drinks, potentially causing different effects on the polymer network. This could lead to short or long-term alterations in the material's structure.14

CONCLUSION:

this study investigated the compressive strength of two single-shade universal composites, Charisma Topaz ONE and OMNICHROMA, after immersion in acidic litchi and cranberry juices. Both composites exhibited reduced compressive strength after 1 week of immersion compared to 24 hours. However, Charisma Topaz ONE demonstrated significantly higher compressive strength overall compared to OMNICHROMA, likely due to its higher filler content. The reduction in mechanical properties over time, especially for OMNICHROMA, suggests potential limitations in longevity when exposed to acidic oral environments. The findings highlight potential

vulnerabilities, especially in OMNICHROMA, suggesting the need for considering real-world conditions. The study emphasizes the importance of filler content, particle size, and matrix composition in resin composite properties. Future research should integrate in vivo assessments to better understand material behavior in oral environments, aiding in clinical decision-making and material development in dentistry.

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