

RESEARCH AND EDUCATION

Effect of acidic drinks on shade matching, surface topography, and mechanical properties of conventional and bulk-fill composite resins



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Composite resins are the primary material for the direct restoration of posterior teeth because of their clinical applicability, physical and mechanical properties, adhesion to tooth structure, and moderate cost.¹ These materials are in a constant process of chemical degradation in the oral cavity due to diets that contain a variety of colored and acidic food and drinks.²⁻¹⁰ Sources of degradation can be intermittent or continuous and can be prolonged by exposure to low pH in the oral cavity.^{11,12}

Composite resin restorative materials are more susceptible to chemical change than ceramic or metal restorative materials and may undergo destruction at the matrix/filler

ABSTRACT

Statement of problem. Posterior composite restorations may be negatively affected by acidic and colored drinks. Little information is available about the effect of acidic drinks on bulk-fill composite resins.

Purpose. The purpose of this in vitro study was to investigate the effect of acidic drinks on the different properties of conventional and bulk-fill composite resins.

Material and methods. A conventional composite resin and 2 representative bulk-fill composite resins were used to prepare disk-shaped specimens. The degree of conversion (DC) was monitored by spectroscopy (n=5). The specimens were divided into 5 groups: control, artificial saliva, acai juice, red wine, and Coca-Cola and were maintained for 30 days of challenge (3 periods of 15 min/d). Surface topography parameters were measured by interferometry (n=5). Elastic modulus (E) and Vickers hardness (VH) were determined by microhardness dynamic indentation (n=5). Diametral tensile strength (DTS) was determined at 0.5 mm/min (n=5). Shade matching was evaluated by using the Vitapan Classic Shade Guide. The DC, Sa, Ssk, Sku, Sdq, and DTS were statistically analyzed using 2-way ANOVA, followed by the Tukey HSD tests. E and VH were statistically analyzed by 3-way ANOVA, followed by Tukey HSD tests ($\alpha=.05$). Shade matching was analyzed with the Kruskal-Wallis test.

Results. DC values were similar for the immediate evaluation and after 24 hours, regardless of the composite resin ($P<.05$). All surface topography parameters increased significantly after the acidic drinks and were greatest for Coca-Cola. The E, VH, and DTS decreased significantly for all composite resins tested ($P<.05$). Acai juice and red wine produced more surface staining than Coca-Cola.

Conclusions. Acidic drinks negatively influenced the physical and mechanical properties of conventional and bulk-fill composite resins. (*J Prosthet Dent* 2019;121:868.e1-e8)

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Clinical Implications

Degradation caused by acidic drinks can negatively influence the physical and mechanical properties of conventional and bulk-fill composite resins. Patients should be informed about the deleterious effects on composite resin restorations caused by the use of acidic drinks.

interface upon an acid attack.^{13,14} Other effects such as the alteration of surface roughness and surface free energy¹⁵ and the decreased microhardness on composite resins after in vitro exposure have also been demonstrated.¹⁶⁻²⁰ In addition, drinks can alter the color of composite resins through the absorption and/or adsorption of colorants during the period of exposure.^{2,3,21,22}

Inadequate adaptation at the tooth-restoration interface, microcracking, postoperative sensitivity, microleakage, and secondary caries are clinical signs associated with the polymerization shrinkage stress of composite resins.²³⁻²⁸ These issues are often responsible for the replacement of posterior composite resin restorations.^{25,26,29,30} Incremental filling techniques have been recommended for posterior restorations to decrease the effects of shrinkage stress and strain generated at the adhesive interface.³¹⁻³⁴ However, bulk-fill composite resins have recently been introduced and have simplified the restorative procedure.^{4,35-37} Restoring cavities with these materials produces less cusp deflection from shrinkage stress, which may improve mechanical performance.^{34,38,39}

The purpose of this in vitro study was to investigate the cumulative deleterious effects of different acidic drinks on shade matching, surface topography, elastic modulus, Vickers hardness, and diametral tensile strength of conventional and bulk-fill composite resins. The null hypothesis was that exposure to acidic drinks does not affect the physical and mechanical properties or the surface parameters of the tested composite resins.

MATERIAL AND METHODS

The sample size calculation was based on data from similar previous studies, and the required sample size was determined to be $n=5$ for degree of conversion,⁴⁰ surface topography,⁴¹ elastic modulus,^{32,42} Vickers hardness,^{32,42} and diametral tensile strength.³⁸

A conventional composite resin (Filtek Z350XT; 3M ESPE) and 2 representative bulk-fill composite resins (Tetric N-Ceram Bulk-Fill; Ivoclar Vivadent AG, and X-Tra Fil; Voco do Brasil Ltda) were tested. The composite resin was inserted into a silicone mold (HydroXtreme; Vigodent S/A Indústria e Comércio) with internal dimensions of 4×2 mm according to International

Standards Organization (ISO) 4049.⁴³ The specimen surface was covered with a polyester strip and pressed flat by using a glass slab. Specimens were light activated according to the manufacturers' instructions for 20 seconds (Z350 and TNC) and 10 seconds (X-TRA) after removal of the glass slab. A light-emitting diode (LED) polymerization light unit (Bluephase G2; Ivoclar Vivadent AG) with 1200 mW/cm², and a light radiometer (Kon-dortech Equipamentos Odontológicos Ltda) were used.

The degree of conversion (DC) ($n=5$) was monitored immediately and then again after 24 hours by Fourier transformed infrared spectroscopy (FTIR/MIR) (VERTEX 70; Bruker Optik GmbH) with a 4 cm⁻¹ resolution and coaddition of 32 scans. Specimens were stored in a dry and dark place at 37 °C for 24 hours and then evaluated. The DC was calculated from the 1638 cm⁻¹ and 1608 cm⁻¹ molar ratios of polymerized (C) and unpolymerized (U) specimens, according to the following equation: $DC=(1-C/U) \times 100$.⁴⁴

The control group was formed by specimens tested after storage in 1.5 mL of artificial saliva (Kiropharma) for 24 hours in a dark place at 37 °C. The other specimens were immersed individually in 10 mL of 4 dietary solutions, including artificial saliva (pH 7), according to ISO 4049 and 3 acidic drinks, including acai juice (pH 3.8), red wine (pH 3.5), and Coca-Cola (pH 2.3), for 30 days of challenge⁴⁵ (3 periods of 15 min/d) at 37 °C. Artificial saliva was exchanged daily. The pH solutions were tested daily by using a portable pH meter (mPA-210P; MS Tecnopon Equipamentos especiais LTDA) and solutions at pH 4.0 and 7.0.⁴⁶ After 15 minutes of storage in each acidic drink, the excess was removed. After 30 days, the specimens were ultrasonically (Ultrasonic Cleaner; California Institute of Technology) washed in distilled water for 10 minutes and dried.⁴⁶

For surface topography testing, specimens ($n=5$) were analyzed by 3D laser interferometry (MicroFocus; UBM Messtechnik GmbH) with a cutoff length of 0.25 mm at a tracing speed of 0.25 mm/s. Measurement densities of 1000 points in the x and 100 points in the y directions were used. The measuring rate was 250 points/s, with a measurement area of 1×1 mm and in axonometric measurement mode. The amplitude parameters (S_a — μm , S_{sk} , S_{ku}) and the hybrid parameter (S_{dq} — $\mu\text{m}/\mu\text{m}$) of each specimen were obtained by using a software program (MountainsMap Universal software v3.0; UBM Messtechnik GmbH) from 3 successive measurements from the center of each specimen in different directions.

The elastic modulus (E) in GPa and Vickers hardness (VH) in N/mm² were evaluated at 8 depths from the surface of the composite resins ($n=5$) embedded with polyester resin (Instrumental Instrumentos de Medição Ltda). Before testing, the surface of the specimens was finished with #600-, 800-, 1200-, and 2000-grit abrasive papers (NORTON SAINT-GOBAIN) and polished

Table 1. Degree of conversion (%) of composite resins*

Composite Resin	Immediate	24 h	Pooled Average
Z350	55.6 ±2.7	56.9 ±1.6	56.2 ±2.9 ^C
TNC	59.4 ±1.9	61.3 ±1.3	60.5 ±2.3 ^B
X-TRA	63.9 ±1.3	64.9 ±1.0	64.4 ±1.5 ^A
Pooled average	59.6 ±4.3 ^a	61.1 ±3.8 ^a	—

*Different uppercase letters in columns compare composite resins. Lowercase letters in rows compare moment of evaluation (*P*<.05).

Table 2. Two-way ANOVA (3×2) for degree of conversion values

Source of Variation	Sum of Squares	df	Mean Square	F	P
Composite resins	335 807	2	167 904	32.119	<.001
Moment	16 625	1	16 625	3.180	.087
Composite resins×moment	2121	2	1061	1.085	.818
Error	125 461	24	5228	—	—
Total	1 440 042	30	—	—	—
Corrected total	480 014	29	—	—	—

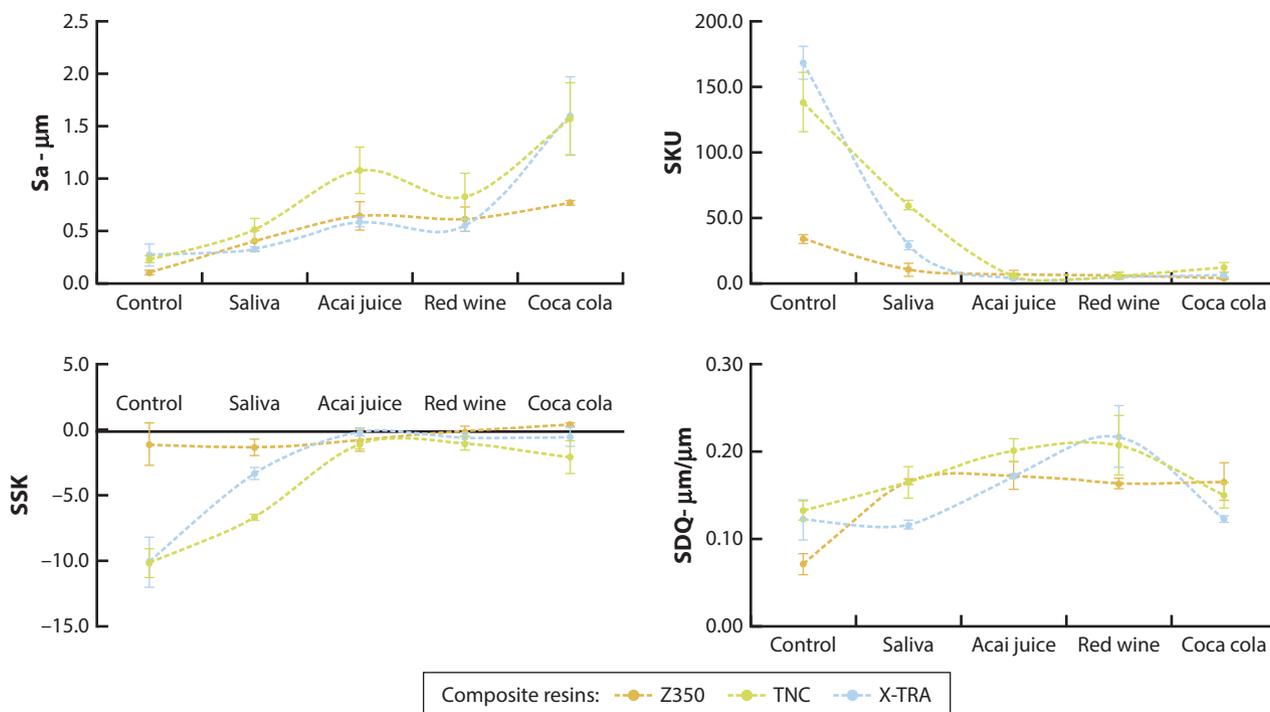


Figure 1. Mean ±standard deviation of surface topography parameters (Sa, ssk, Sku, and Sdq) for Z350, TNC, and X-TRA.

(6-, 3-, 1-, and 0.25-1 m pastes; Arotec S.A. Indústria e Comércio).³² Indentations were made by using a Vickers indenter (CSM Micro-Hardness Tester; CSM Instruments) every 10, 20, 30, 40, 50, 100, 150, and 200 µm to the top of the surface, maintaining a distance larger than 50 µm between indentations.⁴² The test load was increased or decreased at a constant rate ranging between 0 and 500 mN in 60-second intervals.⁴² A maximum force of 500 mN was held for 15 seconds.^{42,47}

The diametral tensile strength (DTS) of each composite resin (n=5) was evaluated in a universal testing machine (EMIC DL 2000; INSTRON BRASIL EQUIPAMENTOS CIENTÍFICOS LTDA) with a coupled flat and cylindrical tip on the testing machine base. Specimens were positioned vertically and submitted to testing with a 0.98-kN load at a crosshead speed of 0.5 mm/min until failure occurred.³⁸ DTS values (MPa) were calculated by using the equation: $DTS=2F/\pi dt$, where F is the fracture load, $\pi=3.14$, d is the diameter, and t is the height of the specimen.

Three different examiners selected a color by using the Vitapan Classic Shade Guide (VITA Zahnfabrik). This process was performed under daylight conditions by clinicians who had different levels of experience and no history of visual color deficiency.⁴⁷ The shade guide and the specimens were moistened and placed under a gray card. The selection was completed by scanning quickly after resting the eye by gazing at a blue card.⁴⁸ The selected shades were scored at 0 to 3 for each participant: 0, no color alteration; 1, slight; 2, moderate; and 3, severe. The examiners were blinded to the judgments of the other 2 examiners.⁴⁹

The DC, Sa, Ssk, Sku, and Sdq parameters and the E, VH, and DTS data were tested by the Shapiro-Wilk ($\alpha=.05$) and Levene tests. A 2-way ANOVA was performed for DC, Sa, Ssk, Sku, and Sdq parameters, as well as DTS. A 3-way ANOVA was performed for the E and VH data, followed by the Tukey HSD test. Color alteration was analyzed with the Kruskal-Wallis test ($\alpha=.05$).

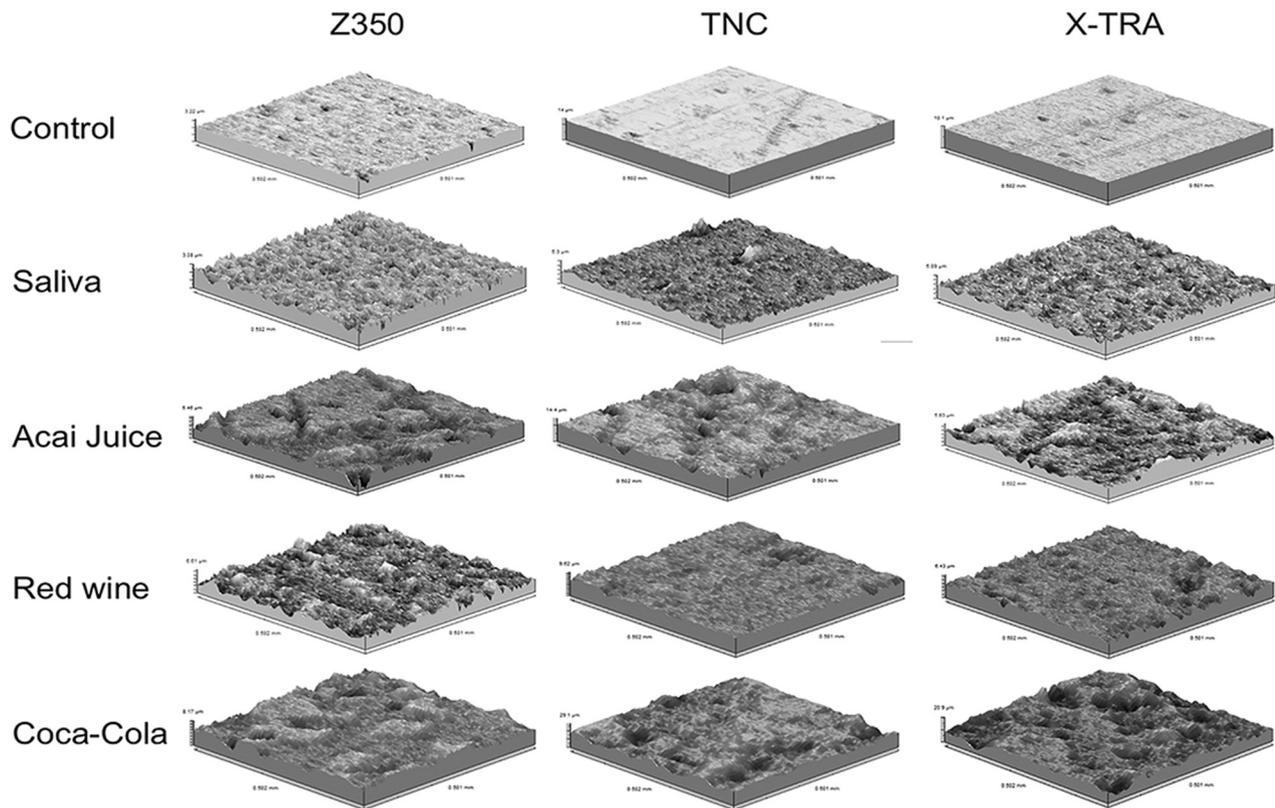


Figure 2. Representative images of surface topography of specimens for each dietary solution.

Statistical software (SigmaPlot v13.1; Systat Software Inc) was used for all analyses.

RESULTS

The DC (%) values of the composite resins are shown in Table 1. The factor moment ($P=.087$) and the interaction between composite resins and moment ($P=.818$) were not significant for DC values. However, the factor composite resins ($P<.001$) was significant, as shown by the 2-way ANOVA (Table 2). The DC was similar for the immediate evaluation and after 24 hours. X-TRA had a significantly higher DC than did TNC, and TNC had a significantly higher DC than did Z350.

Sa, Ssk, Sku, and Sdq parameters are shown in Figure 1. Representative images of the surface topography are presented in Figure 2. The factors composite resins ($P<.001$) and solutions ($P<.001$) and the interaction between them ($P<.001$) were significant for Sa values, as shown by the 2-way ANOVA (Table 3). The factor composite resins ($P<.001$) and solutions ($P<.001$) and the interaction between them ($P<.001$) were significant for Ssk values, as shown by the 2-way ANOVA (Table 4). The factors composite resins ($P<.001$) and solutions ($P<.001$) and the interaction between them ($P<.001$) were significant for Sku values, as shown by the 2-way

ANOVA (Table 5). The factor solutions ($P<.001$) and the interaction between composite resins and solutions ($P<.001$) were significant for Sdq values. However, the factor composite resins was not significant ($P=.006$), as shown by the 2-way ANOVA (Table 6). All tested composite resins had similar Sa values compared with the control group. Storage in Coca-Cola resulted in higher Sa values, followed by storage in acai juice and red wine. The Sa values of TNC and X-TRA were more negatively influenced than Z350 when they were stored in Coca-Cola. Z350 had lower Sku values than did TNC and X-TRA for the control and saliva groups. After storage in acidic drinks, the Sku values were similar for all of the groups tested. Decreasing Sku values were more evident for the TNC and X-TRA composite resins. Z350 had higher Ssk values than did TNC and X-TRA for the control and saliva groups. The Ssk values of Z350 were not influenced by storage aging. After storage in acai juice, red wine, and Coca-Cola, the Ssk values were similar for the other composite resins. The Sdq values were not significantly affected by dietary solutions.

The E (GPa) values at various depths are shown in Figure 3 and Table 7. The factors composite resins ($P<.001$), solutions ($P<.001$), and depth ($P<.001$) and their interaction ($P<.001$) were significant for E values, as shown by the 3-way ANOVA (Table 8). E was constant

Table 3. Two-way ANOVA (3x2) for Sa values

Source of Variation	Sum of Squares	df	Mean Square	F	P
Composite resins	1937	2	0.969	18.051	<.001
Solutions	8976	4	2244	41.816	<.001
Composite resinsxsolutions	3192	8	0.399	7.434	<.001
Error	3220	60	0.0537	—	—
Total	71 972	75	—	—	—
Corrected total	17 324	74	—	—	—

Table 4. Two-way ANOVA (3x2) for Ssk values

Source of Variation	Sum of Squares	df	Mean Square	F	P
Composite resins	165 840	2	82 920	74.877	<.001
Solutions	504 611	4	126 153	113.016	<.001
Composite resinsxsolutions	185 650	8	1107	20.955	<.001
Error	66 445	60	12 467	—	—
Total	2 767 641	75	—	—	—
Corrected total	922 547	74	—	—	—

Table 5. Two-way ANOVA (3x2) for Sku values

Source of Variation	Sum of Squares	df	Mean Square	F	P
Composite resins	21 547 766	2	10 773 883	100.797	<.001
Solutions	111 150 980	4	27 787 745	259.972	<.001
Composite resinsxsolutions	55 001 463	8	6 875 183	64.322	<.001
Error	6 413 235	60	106 887	—	—
Total	782 340 332	75	—	—	—
Corrected total	194 113 444	74	—	—	—

Table 6. Two-way ANOVA (3x2) for Sdq values

Source of Variation	Sum of Squares	df	Mean Square	F	P
Composite resins	0.00640	2	0.00320	5.508	.006
Solutions	0.0349	4	0.00872	15.005	<.001
Composite resinsxsolutions	0.0240	8	0.00300	5.160	<.001
Error	0.0349	60	0.000581	—	—
Total	1.301	75	—	—	—
Corrected total	0.100	74	—	—	—

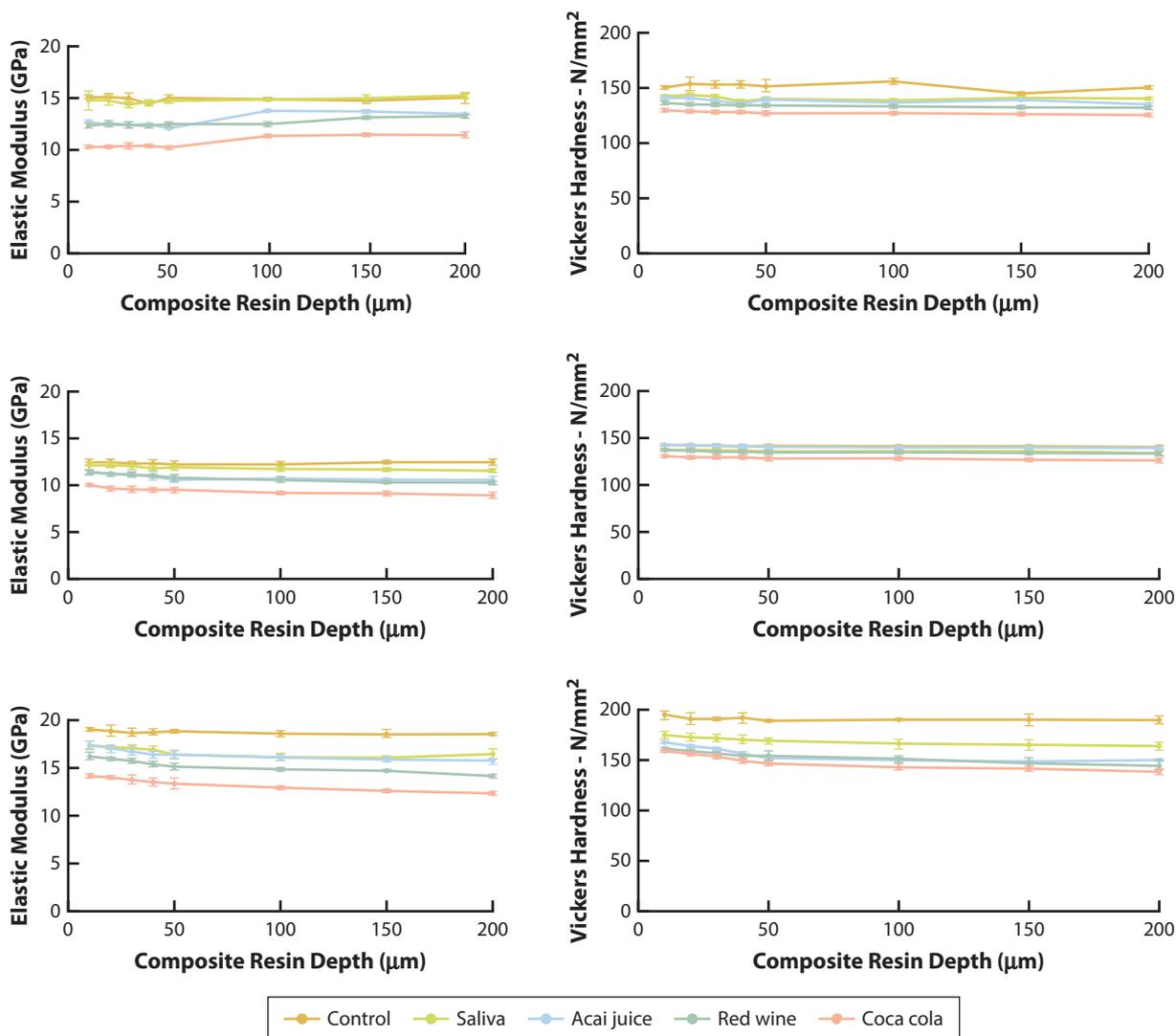


Figure 3. Elastic modulus and Vickers hardness at different depths of composite resins. A, Z350. B, TNC. C, X-TRA.

Table 7. Elastic modulus (GPa) averaged*

Composite Resin	Elastic Modulus, GPa (Mean ±Standard Deviation)				
	Control	Saliva	Acai Juice	Red Wine	Coca-Cola
Z350	14.9 ±0.1 ^{Ba}	14.8 ±0.2 ^{Ba}	12.9 ±0.1 ^{Bb}	12.6 ±0.1 ^{Bb}	10.7 ±0.1 ^{Bb}
TNC	12.3 ±0.1 ^{Ca}	11.9 ±0.2 ^{Ca}	10.9 ±0.2 ^{Cb}	10.8 ±0.1 ^{Cb}	9.4 ±0.2 ^{Cb}
X-TRA	18.8 ±0.3 ^{Aa}	16.8 ±0.2 ^{Ab}	16.5 ±0.3 ^{Ab}	15.3 ±0.2 ^{Ab}	13.4 ±0.3 ^{Ab}

*Different uppercase letters in columns compare composite resins. Lowercase letters in rows compare dietary solutions (*P*<.05).

Table 9. Vickers hardness (N/mm²) averaged*

Composite Resin	Vickers Hardness, N/mm ² (Mean ±Standard Deviation)				
	Control	Saliva	Acai Juice	Red Wine	Coca-Cola
Z350	191.0 ±2.0 ^{Aa}	169.2 ±3.9 ^{Aa}	156.4 ±3.6 ^{Ab}	153.5 ±3.6 ^{Ab}	148.4 ±2.0 ^{Ab}
TNC	152.1 ±0.8 ^{Ba}	141.1 ±1.2 ^{Ba}	138.6 ±1.2 ^{Bb}	134.4 ±1.2 ^{Bb}	128.0 ±0.7 ^{Bb}
X-TRA	141.0 ±0.6 ^{Ca}	140.3 ±1.9 ^{Ba}	136.2 ±1.5 ^{Bb}	134.9 ±1.9 ^{Bb}	128.1 ±1.1 ^{Bb}

*Different uppercase letters in columns compare composite resins. Lowercase letters in rows compare dietary solutions (*P*<.05).

Table 11. Diametral tensile strength (MPa) averaged*

Composite Resin	DTS, MPa (Mean ±Standard Deviation)				
	Control	Saliva	Acai Juice	Red Wine	Coca-Cola
Z350	42.5 ±6.3 ^{Ba}	41.5 ±7.0 ^{Ba}	35.0 ±6.4 ^{Bb}	32.3 ±5.0 ^{Bb}	34.4 ±4.7 ^{Bb}
TNC	39.5 ±8.3 ^{Ba}	38.6 ±6.4 ^{Ba}	37.8 ±4.8 ^{ABb}	35.5 ±8.7 ^{ABb}	35.2 ±8.7 ^{ABb}
X-TRA	48.2 ±3.2 ^{Aa}	47.6 ±9.4 ^{Aa}	41.3 ±5.4 ^{Ab}	38.8 ±6.8 ^{Ab}	39.3 ±7.8 ^{Ab}

*Different uppercase letters in columns compare composite resins. Lowercase letters in rows compare dietary solutions (*P*<.05).

throughout the different depths for all composite resins. X-TRA had the highest E values, followed by Z350 and TNC, regardless of the solutions used. Storage aging in saliva reduced the E values only for X-TRA. Compared with the control group, the E values of all tested composite resins decreased significantly when exposed to all acidic drinks, regardless of the composite resins used. Coca-Cola resulted in a higher E reduction.

The VH (N/mm²) values at various depths are shown in Figure 3 and Table 9. The factors composite resins (*P*<.001), solutions (*P*<.001), and depth (*P*<.001) and their interaction (*P*<.001) were significant for VH values, as shown by the 3-way ANOVA (Table 10). The VH values were constant throughout the different depths for all composite resins. VH values for Z350 were higher, irrespective of solutions. TNC had higher VH values than did X-TRA for the control group and similar values for the other groups. Compared with the control group, the VH of the all tested composite resins decreased significantly when exposed to all solutions, except for the storage aging in saliva, regardless of the composite resins used. Coca-Cola resulted in a higher VH reduction.

The average DTS (MPa) of the 3 composite resins is shown in Table 11. The factors composite resins and solutions (*P*<.001) and the interaction between them (*P*<.001) were not significant for DTS values, as shown by the 2-way ANOVA (Table 12). Storage aging in saliva had no effect on DTS for all composite resins. Compared

Table 8. Three-way repeated measurements ANOVA (5×3) for elastic modulus values

Source of Variation	Sum of Squares	df	Mean Square	F	P
Composite resins	2 583 238	2	1 291 619	13640.262	<.001
Solutions	1 215 541	4	303 885	25.633	<.001
Depth	16 991	7	2427	3209.207	<.001
Composite resins×solutions	104 586	8	13 073	138.062	<.001
Composite resins×depth	59 565	14	4255	44.932	<.001
Depth×solutions	5955	28	0.213	2.246	<.001
Composite resins ×solutions×depth	22 588	56	0.403	4.260	<.001
Error	45 452	480	0.0947	—	—
Total	16 215 664	600	—	—	—
Corrected total	4 053 916	599	—	—	—

Table 10. Three-way repeated measurements ANOVA (5×3) for Vickers hardness values

Source of Variation	Sum of Squares	df	Mean Square	F	P
Composite resins	92 311 202	2	46 255 601	5112.013	<.001
Solutions	48 947 615	4	12 236 904	1355.311	<.001
Depth	3 238 750	7	462 679	51.244	<.001
Composite resins×solutions	1 4592 917	8	1 824 115	202.032	<.001
Composite resins×depth	1 790 583	14	127 899	14.166	<.001
Depth×solutions	570 594	28	20 378	2.257	<.001
Composite resins ×solutions×depth	972 495	56	17 366	1.923	<.001
Error	4 333 848	480	9029	—	—
Total	667 032 016	600	—	—	—
Corrected total	166 758 004	599	—	—	—

with the control group, the acidic drinks resulted in a higher DTS reduction.

Shade matching analysis is shown in Table 13. Saliva had no significant effect on the color alteration of any of the composite resins. Coca-Cola altered the color less than acai juice and red wine.

DISCUSSION

In the present study, the mechanical and physical performances of conventional and bulk-fill composite resins were affected by acidic drinks. Therefore, the null hypothesis was rejected. The surface roughness of composite resins can influence mechanical strength, esthetics, friction, wear, and accumulation of dental plaque.^{19,20} Surface topography analysis using 3D parameters is required for a better description of the entire surface of composite resins. For the Sa parameter, storage in Coca-Cola resulted in higher values, followed by storage in acai juice and red wine. The Sa values of TNC and X-TRA were more negatively influenced than Z350 when they were stored in Coca-Cola, probably because of their type of matrix structure and the size of the inorganic fillers, which are less susceptible to degradation.²⁸ For the Ssk and Sku parameters, Z350 had different values for bulk-fill composite resins compared

Table 12. Two-way ANOVA (5×2) for diametral tensile strength values

Source of Variation	Sum of Squares	df	Mean Square	F	P
Composite resins	797 917	2	398 958	5.529	.006
Solutions	209 513	4	52 378	0.726	.578
Composite resins×solutions	626 535	8	78 317	1.085	.386
Error	4 329 076	60	72 151	—	—
Total	17 889 285	75	—	—	—
Corrected total	5 963 041	74	—	—	—

Table 13. Shade matching analysis*

Composite Resin	Saliva	Acai Juice	Red Wine	Coca-Cola
Z350	0 (5)	3 (5)	3 (5)	1 (5)
TNC	0 (5)	3 (5)	3 (5)	1 (5)
X-TRA	0 (5)	3 (5)	3 (5)	1 (5)

*0, no color alteration; 1, slight color alteration; 2, moderate color alteration; 3, severe color alteration.

with those of the control group. After simulating the use of acidic drinks and contact with saliva, all the composite resins performed similarly.

E and VH are directly related to the wear resistance and durability of composite resins.²⁹ The E values of the composite resin restorative materials modulate the accumulation of stresses in posterior teeth at the interface between the tooth and the restorative material, which are generated by polymerization shrinkage and cusp deflection.³⁹ A significant reduction of E and VH values was detected for all the composite resins tested after storage in the acidic drinks, especially for Coca-Cola with the lowest pH. Coca-Cola has a pH of 2.3, which is much lower than the pH of citric acid, which causes tooth demineralization. Furthermore, no previous study has compared the salivary pH for long periods of time after ingestion of acidic drinks with distinct pH values and titratable acidities of Coca-Cola.¹² This can degrade the organic matrix and change the connection between the silane and filler particles, making the material softer.^{4,29}

DTS is directly related to fracture and wear resistance, which also determines the durability of composite resins.¹³ The effect of acidic drinks on the DTS observed in this study may be reflected in the performance of the marginal integrity of posterior composite resin restorations. Associated with stains produced by colored drinks, this aspect may also lead to a misdiagnosis of secondary caries, which is the main reason for the replacement of restorations.^{29,30}

After 30 days of contact with saliva, no significant color alterations were observed for the composite resins. Coca-Cola changed the color more than acai juice or red wine. This may be because the alteration was not a result of storage aging in saliva. One of most common reasons for this problem is surface changes, which led to slight penetration and reaction of staining

agents on the superficial layer of composite resins.³⁰ Coca-Cola has fewer colorants than the natural pigments contained in acai juice and red wine; therefore, considerable color alteration was observed by all examiners. Previous studies usually used substrates in contact with acidic foodstuffs for a prolonged period of consumption and did not take into account the role of saliva.^{10,21,22} This study simulated the effect of the use of acidic drinks in sequence on the properties of composite resins. After chemical degradation, we recommend that patients reduce their consumption of acidic foods or drinks and be aware of the importance of rinsing with water.

The bulk-fill composite resins performed similar to the conventional composite resin, thus demonstrating a promising alternative for simplifying posterior direct restorations. More studies are still necessary, especially clinical trials, to better respond to the problem of maintaining the longevity of posterior restorations in the presence of acidic drinks.

CONCLUSIONS

Based on the findings of this in vitro study, the following conclusions were drawn:

1. Acidic drinks (acai juice, red wine, and Coca-Cola) had a negative influence on the physical and mechanical properties of conventional and bulk-fill composite resins.
2. Degree of conversion, Vickers hardness, and diametral tensile strength were reduced for all composite resins tested, and surface topography increased significantly after the simulated use of acidic drinks, mainly for Coca-Cola.
3. Acai juice and red wine produced more surface staining than Coca-Cola.

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