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Fluoride Release from Composite Resin in Different Media

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Abstract **Objective**: The present study aimed to measure the fluoride released from composite resins stored in different beverages. **Materials and Methods:** Three composite resins (Te-Econom, Tetric ceram, and VOCO) were used. Twenty specimens for each composite resin were prepared according to the manufacturer instructions, and were divided into four groups (The first group were stowed in deionized water, the second group were stowed in orange juice, the third group were stowed in Pepsi Cola while the last group were stowed in coffee without sugure). The storage solutions were replaced after 7, 15 and 30 days and fluoride release (FR) at the end of each storage period was measured by "fluoride ion selective electrode". **Results:** One way analysis and Duncan test were used to statistically analyze the data. The amount of FR from the tested materials was significantly higher in orange juice (at day 15) than the amount of fluoride released in coffee and Pepsi Cola. The amount of fluoride released from the tested materials was significantly higher in Pepsi cola (at day 7) than the amount of fluoride released in orange and Pepsi cola. **Conclusion:** The ability of restorative dental materials to slowly release fluoride ions may provide a positive advantage in terms of recurrent caries inhibition.

Keywords: *storage media, fluoride release, composite resin*

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1. Introduction

The conservative dentistry field predicted Composite resin to decrease the side effect of the acrylic resin that replaced silicate cement [1,2].

Remark secondary caries formation was seldom associated with fluoride silicate restorations increasing attention on the development of different FR products to be used as an anticariogenic agent [3]. Fluoride is involved in variety of mechanism of fluoride are involved in the anticariogenic including the decrease de_mineralization, the augmentation of re_mineralization, the interfering with formation of plaque and the inhibition microbial growth and metabolism. FR from restorative materials is presumed to affect caries formation through these mechanism may decrease or prevent de_mineralization increase re_mineralization of dental hard tissue [4].

FR is influenced by basic variable such as formulation and filler, also affected by the oral environment and the experimental environment (i.e. storage media, composition and saliva pH and formation of plaque) [5].

The correlation between the fluoride electrode's potential (ET in millivolts mV) and the fluoride ion concentration can be derived from the Nernst equation and is as follows at 25°C: E_T (in mV)= α-β log[F^-]

A plot of mV of electrode potential versus the log (F^- concentration) should be a straight line with a negative slope. You will determine the value of the slope (-*β*) and intercept (α) based on a series of standard solutions containing known concentrations of F^- [6]. This study is inspected the interface of different types of composite resin restorative materials with stowage media and to identify the amount of FR from composite resins into different stowage solutions.

2. Materials and Methods

Three types of light curing composite restorative material were used in this study as listed in Table 1.

Table 1. Materials

Materials	Type of material	Composition
Te-Econom (IvoClar Vivadent, India)	Hybrid composite	Bis-GMA, Ytterbium trifluoride, Urethane dimethacrylate (UDMA), Triethyleneglycol dimethacrylate (TEGDMA)
Tetric-ceram (IvoClar Vivadent, India)	Microhybrid composite	Bis-GMA, Ytterbium trifluoride, UDMA, TEGDMA
Voco (Cuxhaven, Germany)	nanohybride	Bis-GMA, Ytterbium trifluoride, UDMA, TEGDMA

2.1. Total Ionic Strength Adjusting Buffer (TISAB) Preparation

According to the previous articles 7 the TISAB was prepared [7] to buffer the stowage solution to provide a constant solution a known pH and de-complex fluoride.

2.2. Specimen's Preparation and Fluoride Release

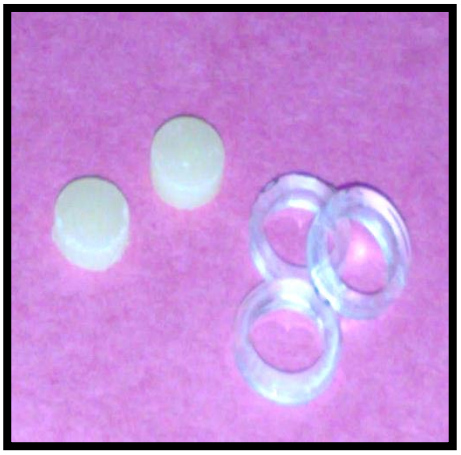

Figure 1. Polyethylene Ring

The dimension of specimens was 2mm height and 5mm diameter (Figure 1) [8,9]. The specimen discs of composites were prepared using Polyethylene mold composite resin were directly applied into the mold over glass slip then covered by a celluloid strip and according to the manufacturers' instructions by conventional LED light curing unit(YZB/0155-2013/china) were cured directly to samples with exception the celluloid strip thickness [10]. Twenty specimens to each materials were separated into four groups: deionized water (pH=12) stowed (control group), second group was stowed in orange juice(coun=100,pH=2.63), third group was stowed in Pepsi (pH=3), last group was stowed in coffee (pH=6) (n=5). The specimens were stowed at room temperature 24±1°C) for seven, fifteen and thirty days, each specimen was storage inside glass vial containing 3ml of the storage solution, after immersion time prescribed removed the discs from the solution, dried with an absorbent paper and transferred to new solution [11]. The storage solution at each stowage period end was buffered with TISAB equal volume and the FR was measured.

2.3. Fluoride Measurement

Radiometer with the fluoride ion selective electrode (PHM82, stan-dard pH-meter, Copenhagen, Denm-ark) used to FR measurement. The millivolts (mV) is measuring unit, then the reading from the expedient was pointed to the standard solution curve. According to the calibration curve method [12] Determined the reading by use of the regression equation to obtain the concentration(C) of the fluorideion(ppm).

Regression equation:

$$mV = 39.2 + 5.91Logc.$$

Statically analysis were used one way analysis and Duncan.

3. Results

The mean FR from tested materials (Te-Econom, Tetric ceram and VOCO) into different storage media (orange juice, coffee drink and Pepsi cola) after 7days with Duncan's test result showed in Figure 2. The highest fluoride amount were release from the three composite resin types (Te-Econom, Tetric ceram and VOCO) into the Pepsi cola solution storage media and orange media compared with deionize media.

The variance analysis results (Table 2) showed that the FR value (ppm) from specimens of the materials stowed at different media after 7 days. There are significantly ($p \leq 0.05$) than amount of FR in the three composite resins.

Figure 3 showed the mean FR from tested materials into different storage media (orange solution, coffee drink, Pepsi cola) after 15days with Duncan's test result. The highest amount of fluoride was released from the Tetric ceram into the orange storage media followed by the VOCO and Te-Econom in the same media compared with deionized media. (Table 3) showed the analysis of variance results which compared the FR value (ppm) of specimens of the materials stowed at different media after 15 days' storage, there were significantly ($p \leq 0.05$) than amount of FR in the VOCO and Tetric Ceram. Figure 4 showed the mean FR from tested materials (Te-Econom, Tetric ceram and VOCO) into various storage media (Orange juice, coffee drink, Pepsi cola) after 30days storage with Duncan's test result. The highest amount of fluoride was released from the VOCO into deionized media.

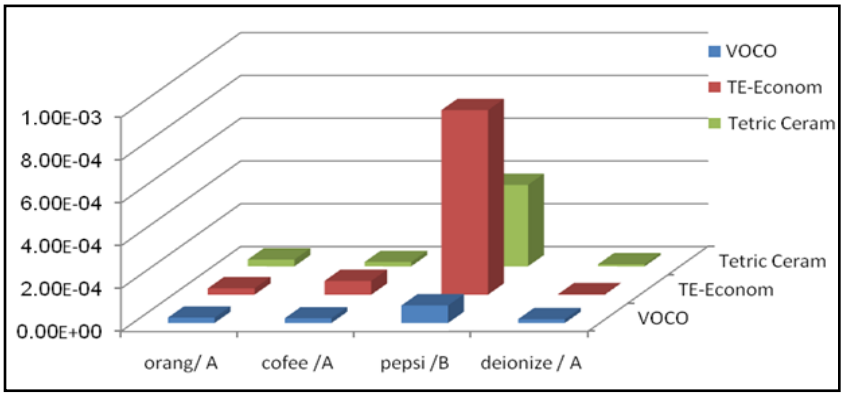

Figure 2. Mean and Duncan's test of FR after 7 days

Table 2. ANOVA result of FR of different materials after 7 days

		Sum of Squares	df	Mean Square	F	Sig.
VOCO	Between Groups	1.38403E-08	3	4.61344E-09	9.254877259	.001
	Within Groups	7.97579E-09	16	4.98487E-10		
TE-ECONOM	Between Groups	2.59656E-06	3	8.6552E-07	5.260666433	.010
	Within Groups	2.63243E-06	16	1.64527E-07		
TETRIC CERAM	Between Groups	4.88293E-07	3	1.62764E-07	23.26334782	.000
	Within Groups	1.11945E-07	16	6.99659E-09		

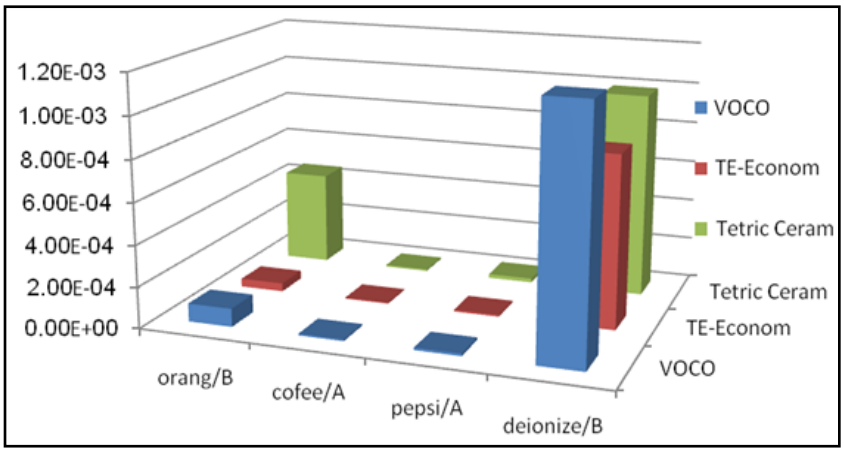

Figure 3. Mean and Duncan's test of FR after 15 days

Table 3. ANOVA result of FR of different materials after 15 days

		Sum of Squares	df	Mean Square	F	Sig
VOCO	Between Groups	5.00937E-06	3	1.6698E-06	40.71500643	.000
	Within Groups	6.56187E-07	16	4.1012E-08		
TE-ECONOM	Between Groups	2.49424E-06	3	8.3141E-07	51361.73913	.000
	Within Groups	2.58998E-10	16	1.6187E-11		
TETRIC CERAM	Between Groups	3.24096E-06	3	1.0803E-06	75.47540338	.000
	Within Groups	2.29017E-07	16	1.4314E-08		

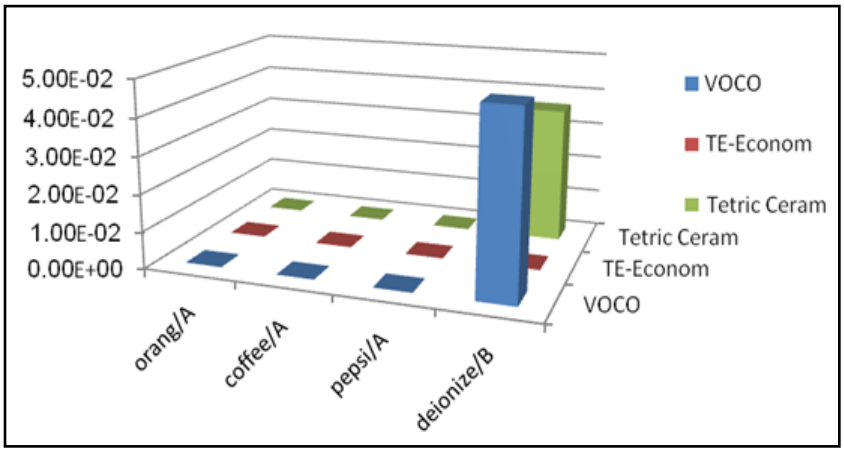

Figure 4. The mean and Duncan's test of FR after 30 days

Table 4. ANOVA result of FR of different materials after 30 days

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	0.008921927	3	0.00297398	104.0571675	.000
Within Groups	0.000457283	16	2.858E-05		
Between Groups	4.42902E-07	3	1.4763E-07	193.8725412	.000
Within Groups	1.2184E-08	16	7.615E-10		
Between Groups	0.005001157	3	0.00166705	6.188286151	.005
Within Groups	0.004310214	16	0.00026939		

Table 4 showed the analysis of variance results which compared the different media after 30days there are no significantly ($p \geq 0.05$) between volume of FR in all storage media compared with deionized water.

4. Discussion

Dental researchers have paid a considerable attention to fluoride releasing restorative materials, because these materials may provide a useful source of low FR over a long period of time and that have benefit in resisting the acidic conditions present in the mouth and may prevent the occurrence of secondary decay, and these beverages causing caries were used because of high acidity and/or contain high sugars and the goal was to obtain an atmosphere similar to the conditions that occur in the mouth. The elution of fluoride influenced by storage media**,** composition and saliva pH [13] deionized water was used in study to ensure that FR would be unaffected by these variables [14].

Figure 2 showed the highest amount of FR from three composite resin types into the acidic media (Pepsi cola) compared to the deionized water media after 7day, Figure 3 showed that the highest amount of FR from three types of composite resins into the acidic-media (orange). Depending on these result positive relationship between the amount of FR and acidic in other words the increased the storage solution acidity caused more FR from the material. This results bargain with the results of Gandolfi [11].

The FR increasing in acidic solution can be explained this point by a reduction in pH increase the de_composition of the material [15,16].

Our results suggest that the FR happens by two different methods as earlier described by Vieira et al. [16]. The first is initial FR from the surface is attended by the second dispersal in which a low amount of flourid remain to be released for a long period of time into the surrounding medium [18,19].

The maximum FR values were experimental in the pH cycling Figure 2 as associated to the de_ionized water, there is a greater FR also described by Carvalho and Cury [19].

The FR provided evidence on the evolution of the restorative materials. The properties of a composite associated with fluoride advantages, as the capability to minimize the plaque by enzymatic action and decreased the de_mineralizing of the enamel contributed clinically to the maintenance of the oral health. Additionally, interest of fluoride prevention of secondary caries [20].

5. Conclusions

The FR increased significantly in the acidic environment. A small amount of fluoride (which may contribute to recurrent caries inhibition) continues to release into the different beverages.

Ethical Statements

The avoidance of the risk of plagiarism and respect for intellectual property; Respect for the rights of human subjects in research; The identification of and dealing with allegations of research misconduct; The identification of and dealing with manipulations of citations; The disclosure of any conflicts of interest.

Conflict of Interest

The authors of this articlar declare no conflict of interest.

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