



EFFECT OF ALCOHOLIC AND NON –ALCOHOLIC BEVERAGES ON COLOUR STABILITY OF COMPOSITE RESIN –AN IN VITRO STUDY

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ABSTRACT Resin composites are widely used because they have excellent aesthetic properties and can be bonded to dentin and enamel. This study aims to determine the colour stability of composite resins (nanohybrid composite and giomer.) after their exposure to commonly consumed beverages namely tea, coca-cola and alcoholic beverages.

Methods and Material: A total of 80 composite resin specimens were made in the form of disks and were immersed in beverages divided into four groups.

Group 1 Test solution tea and artificial saliva

Group 2 Coca-cola and artificial saliva

Group 3 Rum and artificial saliva

Group 4 Artificial saliva (control group).

The colour change was assessed at the intervals of 24hrs, 15th day and 30th day of immersion with the help spectrophotometer.

Results: When discoloration of two resins composite was considered the overall maximum discoloration took place in giomer as compared to nanohybrid composite resin and the results were statistically significant. When discoloration in different beverages was considered maximum discoloration took place in coca-cola>tea>rum>artificial saliva. Newer composites show lesser discoloration

KEYWORDS : colour stability, spectrophotometer,

INTRODUCTION

Aesthetics plays an important role in dentistry and dental research. The trend towards the natural look has paved the way for the development of tooth coloured restoratives that simulate the tooth as closely as possible¹

Self curing acrylic resins were developed in 1930 in Germany but they became popular in dentistry in late 1940s, they showed poor physical properties like high polymerization shrinkage and co-efficient of thermal expansion, lack of wear resistance, poor marginal seal, irritation to pulp and dimensional instability^{2,3}.

To overcome these problems, quartz powder was added to resin to form a composite structure. Addition of inert filler particles reduced the thermal expansion, polymerization shrinkage and water sorption of acrylic resins but decreased the physical and mechanical properties. Another problem in the early composites was lack of proper bonding between resin and the filler particles. A major advancement was made when Dr. L. Bowen (1962) developed a new type of composite. He invented a new dimethacrylate resin, such as Bisphenol A Glycidyl methacrylate (Bis-GMA) and an organo silane coupling agent, which provides a bond between filler particles and the resin matrix⁴.

Composite curing is done by using visible light (427-491nm) which had advantages over uv light which was used previously⁵. This is currently in use and is undergoing further development. The field of composite development has been witnessing continuous development since its advent, which makes it necessary for practitioners to keep abreast continually. Research and Development of resin based composites during the last decade has generated different subspecies of restorative materials like the hybrid resin composites, the fine hybrid resin composites, and the microfill composites.⁶

Continued effort in reducing the size of fillers to improve properties has led to development of dental composites based on nanotechnology. The newly available nanomaterials are nanocomposites and nanohybrids Both approaches can provide good composite materials, but the nanohybrid approach still may suffer from the loss of larger particles and the potential loss of initial gloss⁷. However researchers have proven that true nano-hybrid composites have high color stability and can retain high surface luster.⁸

Another class of composite with additional advantage of fluoride release is 'Giomer'. The "Giomer" is a unique class of restorative materials that have the distinguishing feature of a stable surface prereacted glass core (S-PRG) that is coated with an ionomer lining in a resin matrix. This arrangement allows for protection of the glass core from moisture, giving it long-term esthetics and the durability of conventional composites with ion release and recharge.⁹

Consumption of certain beverages may affect the esthetic and physical properties of resin composite thereby undermining the quality of restorations. Ethanol can produce erosion and alter some properties of composites as well.¹⁰

Therefore current study aimed to check the colour stability of newer composite resin when exposed to exogenous environment

OBJECTIVE:

- 1) To evaluate the colour stability of nanohybrid and giomer restorative materials after their exposure to commonly consumed beverages (tea, coke, rum) using a spectrophotometric analysis.
- 2) To compare the colour stability of nanohybrid composite resin and giomer.

MATERIALS

Sr no	Materials	Composition	Manufacturer	Product details
1	Nanohybrid composite (NT PREMIUM)	Bis-GMA, Bis-EMA, TEGDMA, EDAB, Photoinitiator, fillers, pigments.	COLTENE	BODY A2
2	giomer	Multi-functional glass and S-PRG filler based on fluoroaluminosilicate glass, Bis GMA/TEGDMA resin	SHOFU	BODY A2
3	Red label (TEA)			
4	Coke		HIDUSTAN COCA-COLA BEV.PVT LTD	

5	Rum		Khodays	
6	Artificial saliva	0.4g sodium chloride,1.21g potassium chloride,0.78g sodium dihydrophosphate dihydrate,0.005g hydrated sodium sulfide,1g urea,1000ml of deionized water.10Nsodium hydroxide was added to this mixture until ph value was measured to be as 6.75+ 0.15.Later mixture is sterilized in an autoclave.		
7	Incubator			
8	Test tube	10ml		
9	Teflon mould (10mm diameter 2mm thickness)			
10	Glass slides			
11	LED curing light	DENTSPLY		
12	Reflectance spectrophotometer.	X Rite		

PREPARATION OF STAINING SOLUTION:

TEA (BROOKE BOND, MUMBAI INDIA)

For preparation of tea solution 5.6g tea powder was taken and is added to 300ml of distilled water.in order to avoid less volume of prepared solution during boiling due to vapour loss additional 5 to 6ml of distilled water is added from which 10ml of tea solution was taken.280ml of tea solution was taken and mixed with 280ml of artificial saliva,from which 10ml of tea solution was taken.

COCA-COLA (HIDUSTAN COCA-COLA BEV PVT LIMITED)

280ml of coca-cola was taken as such and mixed with 280ml of artificial saliva,from which 10ml of coca-cola solution was taken

RUM (KHODAYS) 280ml of rum was taken as such and mixed with 280ml of artificial saliva from which 10ml of rum solution was taken

ARTIFICIAL SALIVA: This mixture was sterilized in an autoclave.

Specimens were immersed in their respective solutions at 37degreeC.In each solution,artificial saliva was used in order to simulate the oral conditions in an incubator

SAMPLE PREPARATION

Composite disc were made using polyfouroethylene mold having dimensions 10mm in diameter and 2mm in thickness.A glass slides was then placed,over filled mold to provide smooth surface after which it was light cured using LED curing light and polished.

METHOD

The study materials selected are two composite namely Nanohybrid composite (NT Premium), Giomer (Beautiful). The shade A2 was used as it is considered the universal shade. The test solutions include tea, coca-cola ,rum and artificial saliva which will act as an control group. Immersion of specimens in staining solutions:

To evaluate the colour stability in different solutions, total of 80 specimens were divided into 2 groups having 40 specimens each of nanohybrid composite resin and Giomer (n = 10) as follows:

N	NANOHYBRID	40SPECIMENS
G	GIOMER	40SPECIMENS

The nanohybrid group of resin material is again subdivided in four sub groups for four different solutions as follows:

N1,N2,N3,N4,N5,N6,N7,N8,N9,N10	FOR TEA SOLUTION
N11,N12,N13,N14,N15,N16,N17,N18,N19,N20,	FOR COCA-COLA SOLUTION
N21,N22,N23,N24,N25,N26,N27,N28,N29,N30,	FOR RUM SOLUTION

N31,N32,N33,N34,N35,N36,N37,N38,N39,N40	FOR ARTIFICIAL SALIVA
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For giomer group of resin material is again subdivided in four sub group for four different solutions as follows:

G1,G2,G3,G4,G5,G6,G7,G8,G9,G10,	FOR TEA SOLUTION
G11,G12,G13,G14,G15,G16,G17,G18 ,G19,G20,	FOR COCA-COLA SOLUTION
G21,G22,G23,G24,G25,G26,G27,G28 ,G29,G30,	FOR RUM SOLUTION
G31,G32,G33,G34,G35,G36,G37,G38 ,G39,G40.	FOR ARTIFICIAL SALIVA

The samples are stored in test tube during test period:

Total no.of test tubes for tea solution-20

Total volume of test tubes for tea-10x20ml=200ml

For coke and rum solutions i.e coke mixed with artificial saliva and rum mixed with artificial saliva same measurements were carried out and test solutions were stored in test tubes.

The test tubes were named after the material and the type of test solutions.

Nanohybrid composite (NT PREMIUM) in tea	N1T
Nanohybrid composite (NT PREMIUM) in coca-cola	N11C
Nanohybrid composite (NT PREMIUM) in rum	N21R
Nanohybrid composite (NT PREMIUM) in artificial saliva	N31A

Same method was followed for the other resins to be tested.

The samples were stored for a period of one month at room temperature in an incubator to maintain a constant temperature. The test solution were changed every seventh day following same procedure as mentioned previously.

At the time of colour measurements the samples were removed from test solutions dipped in distilled water for 10minutes, wiped with tissue paper and placed on the thermacol platform. Readings were taken with the help of reflectance spectrophotometry.

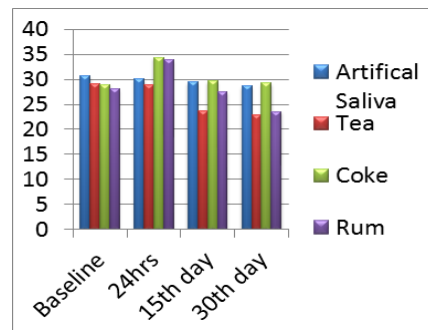
RESULTS

There are three variables in this study two composite resin, four immersion solutions and five time intervals. The interaction between these variables produced statistically results in colour change.

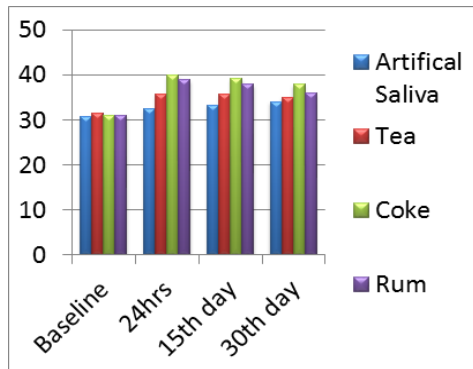
When discoloration of two resin composite was considered i.e nanohybrid composite resin and giomer the overall maximum discoloration took place in giomer as compared to nanohybrid composite resin and the results were statistically significant.

When discoloration in different beverages was considered maximum discoloration took place in coca-cola>tea>rum>artificial saliva.

Graph 1 & 2 shows the graphical representation showing the overall increase in the discoloration of various groups. Least colour change was seen in the specimens immersed in the artificial saliva. Two way ANOVA and Bonferroni test were used to find difference in colour change when two resin restorative materials were immersed in different beverages. The level of significance was set p=0.05. There was a significant difference in the colour change between the two restorative resin when it was immersed in four different solutions after 24hrs, on 15th day and on 30th day



Graph 1. N.T PREMIUM



Graph 2: GIOMER

DISCUSSION

The present study was conducted on two resin composites i.e giomer and nanohybrid composite resin.

Discoloration can be evaluated with various instruments. Instruments are preferred to eliminate the subjective interpretation of visual colour comparison. Spectrophotometer and colorimeter, applied in both in vitro and in vivo environments, have made it possible to study the numerous parameters related to composite colour stability. Colorimeter consists of sensor and simple data processor and has a set of illuminant and observer combination. It isolates the broad band of wavelengths using a tri stimulus absorption filter, whereas spectrophotometer consists of a sensor plus data processor or computer with software. In comparison to colorimeter it isolates narrow band of wavelengths using prism, grating or interference filter, making it more sensitive in detecting wavelength of colour change^[11].

Color change (ΔE) mathematically expresses the amount of difference between the $L^*a^*b^*$ coordinates of different specimens or the same specimen at different instances. The Commission Internationale de l'Eclairage (CIE) $L^*a^*b^*$ color system, which is related to the color perception of the human eye for 3 coordinates, is an approximately uniform color space with coordinates for lightness, namely white-black (L^*), red-green (a^*), and yellow-blue (b^*). A ΔE value of 3.7 or less is considered to be clinically acceptable^[12]. Spectrophotometers contain monochromators and photodiodes that measure the reflectance curve of a products colour every 10nm or less.¹³

Giomer has S-PRG filler particles in resin composite. These particles function on the basis of a reaction between polyacrylic acid and fluoroaluminosilicate glass and are capable of fluoride release as well as recharge¹⁴.

This study found colour change values of giomer composite to be higher than those of the nanohybrid composite. This is in accordance with the study conducted by K Rajavandra et al who concluded that fillers tend to fall out from resin materials in giomer and the matrix component decomposes when exposed to low pH environment This means that drinking acidic drinks over a long period and with continuous sipping can erode the tooth enamel and the resin material as well¹⁵.

In this study composite resin immersed in coke solution showed maximum colour difference as compared to samples immersed in other solution. Previous studies have shown surface degradation occurs when resins have been immersed in acidic beverages^{16,18}

Han et al. evaluated the surface degradation of flowable resins exposed to different acidic drinks (orange juice, whisky and wine), and concluded that a relationship was observed between filler volume and the surface degradation of flowable resins; and, distribution density of fillers on resin surface was related to the surface degradation of flowable resins and surface degradation of flowable resins was also related to the surface treatment of fillers with silane. This means that the lower is the filler loading, the greater is the surface degradation. Filler loading in nano-composite is higher than giomer ,hence better colour stability is seen.¹⁸

According to studies conducted by J Qamaruz Zaman et al Alcohol affects the colour of composite resins through softening of the surface

material, facilitating the absorption of external pigments¹⁹. In addition, Satou et al believe that the discolouration of composite resins is the result of binding between hydrophilic un-reacted component in the initiators in the composite resins and the hydrophilic pigments in the exogenous agents e.g. red wine.²⁰

According to the studies conducted by Mohammed Reza et al where he immersed the composite resin in four different staining solution such as tea,lemonade,coffee and cola and concluded that maximum staining potential was seen in specimens immersed in tea and is caused due to adsorption of polar colorants onto the surface of the resin composite materials which could be removed by brushing the teeth,²¹.

In the present study specimens immersed in tea solution didn't show maximum colour difference as compared to specimens immersed in coke solution.This could be due to the delayed interaction of the composite resin with the tannin pigments present in the tea as compared to the erosive nature that had taken place in specimens immersed in coke solution which attracted the coloured pigments causing maximum colour difference.

CONCLUSION

In present study, it has been shown that nanohybrid composite resin are relatively colour stable as compared to giomer and coke has shown to cause maximum discolouration in samples. This needs to be further evaluated clinically since in-vivo many other factors come into picture like action of saliva,dentrifice used for brushing etc

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