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Evaluation of extrinsic discoloration of new alkasite resin with the microhybrid composite using natural beverages: An *in vitro* study

Yadav Chakravarthy and AC Raja Nanthini

Abstract
Background: Consumption of certain beverages may affect the esthetic and physical properties of the resin composite and the alkasite material, thereby undermining the quality of restorations.
Aim: Evaluated (*in vitro*) the quantum of extrinsic discoloration when alkasite composite resin and micro-hybrid composite were subjected to Tea (camelia sinensis) for a specific period of time
Materials and Methods: A micro filled composite and alkasite material is used. Each material was randomly divided into group of 10 samples each according to the beverages used (tea). The samples were immersed in this beverage for 24hrs for 10 days. Color change was observed by spectrophotometer.
Statistical analysis used: Independent T test were used to find the difference in color change in the resin composites and alkasite material when immersed in Tea solution.
Results: To check the significance of the difference in OD values between two materials, the independent t test is used. Since the p value is less than 0.01, it is found that there is highly significant difference in optical density values between the two materials namely the Alkastite composite resin and Micro hybrid composite resin.

Keywords: Beverages, color change, resin composite, alkasite material

Introduction

Esthetic dental appearance is one among the most important requests of a patient.
Esthetic treatment options currently available includes: Bleaching of tooth, veneers, tooth colored inlay/onlay using various esthetic restorative materials like dental composite resins, dental ceramics, glass ionomer cements, etc...
Dental composite resin is the most commonly used esthetic product in restorative dentistry.
Three types of discolorations are generally described.

1. External discoloration due to the accumulation of plaque and surface stains (extrinsic stain),
2. Surface or sub-surface colour alteration implying superficial degradation or slight penetration and reaction of staining agents within the superficial layer of composite resins (absorption), body, or
3. Intrinsic discoloration due to physical-chemical reactions in the deeper portion of the restoration.

Esthetic materials should fulfill certain important requisites. Ideal requisites of an esthetic materials include:

a. It should be tooth coloured (translucent, opalescent, and fluorescent).
b. Should bond to the tooth.
c. Should be radio-opaque (for appearance in radiograph).
d. Should have good handling characteristics.
e. Should be moisture insensitive.
f. Should not be soluble nor absorbable.
g. Should possess adequate strength (compressive and flexural).
h. Coefficient of thermal expansion should be similar to that of the tooth.
i. Should be durable.
j. Should be dimensionally stable.

k. Should be bio-mimetic in nature.
l. Should be highly polish able.

Mostly the esthetic materials fulfill the mentioned requisites, however over a period of time, the restoration is subject to discoloration due to various reasons like structural changes in aging[7], intake of certain medicines or beverages[3] which results in changes in surface morphology and extrinsic staining affecting the esthetic part of the treatment leading to the failure of the restoration.

The evolution of the dental composite resins has increased tremendously, incorporating various filler technology like nano-fills, micro-fills, nano-hybrids which helped to overcome the drawbacks met by using conventional composites like improved strength and esthetics with low wear rate.

One of those filler-based advances include micro-filled composite which has the advantages over conventional/macro-filled composites by its highly polishable property making the tooth look like translucent, thus providing excellent esthetics especially in anterior restorations.

Recently, the newer alkasite composite resin with various glass fillers has come to use as the tooth colored restorative materials with good strength and excellent esthetics.

However, over the years, the composite restored teeth could be subjected to discoloration because of various reasons. most commonly being associated due to regular consumption of tea. Among most commonly used beverages, tea has been found to have maximum staining effect on teeth due to its "tannin" content (an organic substance found in plants), which gets build up on tooth enamel over a period of time leading to staining of the teeth [11].

Aim: Evaluated (*in vitro*) the quantum of extrinsic discoloration occurring in alkasite filler containing composite resin (cention N) with that of micro-hybrid composite resin (Te-econom-plus) when subjected to Tea (camelia sinensis) for a specific period of time.

Objective: Investigated whether the regular consumption of Tea, may have any potent color changes, that might affect the esthetics of the tooth when alkasite composite resin (cention N) is used as an anterior restorative material.

Materials and Methodology

Preparation of solutions

Tea solutions were prepared from the extracts of camelia sinensis (organic India). Each group of samples have been immersed in this solution about 24hrs for 10 days [9].

Fig 1: Preparation of the tea solution (Camelia sinensis)

Preparation of samples

A total of 20 samples have been prepared from micro hybrid composite resin (TE-ECONOM PLUS) and alkasite composite resin (CENTION N) using 10 silicon molds (4mm in diameter and 2mm in thickness)

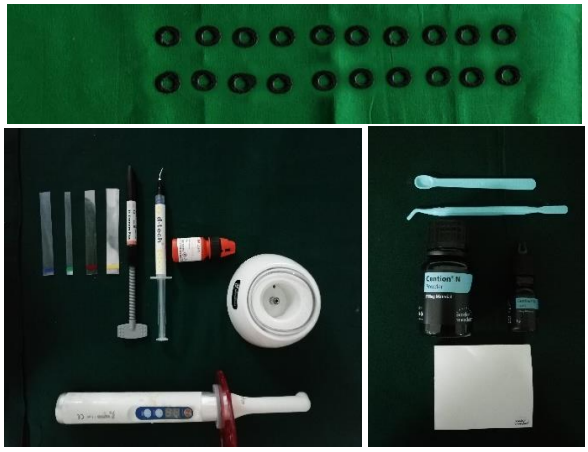


Fig 2: Materials used

Methodology

The micro hybrid composite (te econom plus) and alkasite composite resin (cention- N) were polymerized with a curing light (celaux II, Voco, Cuxhaven, Germany) into 160 silicon molds (4mm in diameter and 2mm in thickness) to obtain identical specimens.[2] Ten samples from each composite and alkasite resin were prepared and the specimen were polished using an automated polishing machine with sequence of 600, 800, 1000 grid abrasive paper under water irrigation [5].

Fig 3: Immersion of samples in tea

The specimens were immersed in tea and distilled water and dipped for 20 mins once a day every 24 hrs. for 10 days into the Tea solution [9].

The specimen was then bleached with carbamide peroxide at 17%, the color specimen was measured by the spectrophotometer according to the CIW L*a*b system [9]. The color difference h-index (DEab*) between each measurement was calculated. Various studies reported the advantages of using the CIE L*a*b* coordinate system, such as its repeatability, sensitivity, and objectivity [1]. This technique is well suited for the determination of small color variations (ΔE).

Fig 4: Spectrophotometer reading

Results

Sample 1–Alkasite composite resin {Cention N}

Sample 2–Micro hybrid composite resin [Te – econom – plus]

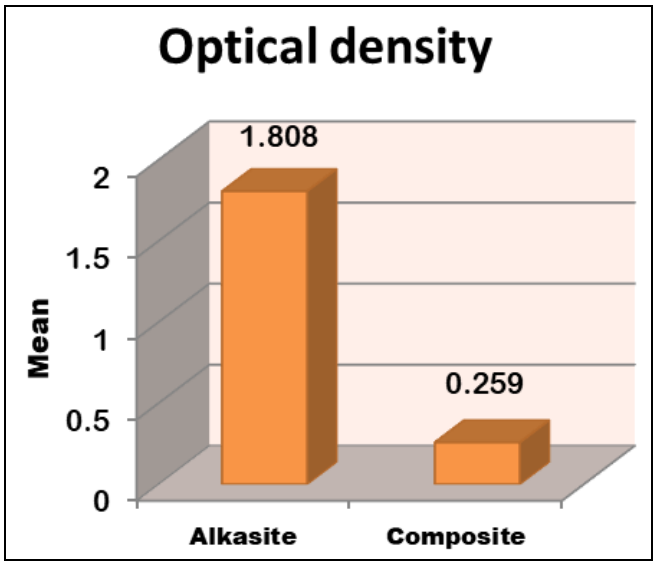
Spectrometer readings was taken at 490 nm in which the staining effect by tea solution was found to be higher in alkasite composite resin samples (1.808 OD) compared to the micro hybrid composite (0.259 OD) with the variation of:

Table 1: Statistical analysis

Samples	Mean ± S. D	Indep T test	P value
Alkasite composite resin {Cention N}	1.81 ± 0.03	51.92	0.001**
Micro hybrid composite resin [Te – econom – plus]	0.26 ± 0.09		

** Highly significant

To check the significance of the difference in OD values between two materials, the independent t test is used. Since the p value is less than 0.01, it is found that there is highly significant difference in optical density values between the two materials namely the Alkastite composite resin and Micro hybrid composite resin.



Graph 1: Spectrophotometer evaluation

Major drawback of esthetic materials is the staining effect due to various beverages. In this study, tea has been used to evaluate the color changes in two different materials (alkasite composite resin- cention N) and (micro hybrid composite resin- Te-econom-plus). Experimental results show that the significant color difference between two materials is high in which alkasite composite resin has more staining effect by tea compared to the micro hybrid composite resin to a certain level.

Discussion

Tooth discoloration has been broadly categorized as surface, extrinsic and intrinsic color changes. INGLE defined tooth discoloration as "Any changes in hue, color/translucency of the tooth due to any cause; restorative materials, drugs (both topical/systemic), pulp necrosis/hemorrhage may be responsible" [6]. The treatment modalities to overcome these discolorations includes veneers, laminates/ tooth colored inlay/onlay using various materials like ceramic, composite [12] There are various composite materials available from macro filled/traditional to recent nano filled composite. The structural component of the composite resin and the characteristics of its particles have a direct impact on susceptibility to extrinsic staining. Moreover, the composite resin undergoes superficial and micro structural changes resultant from mastication and finishing and polishing procedures. Recently introduced alkasite composite resin have a potent filler content "ytterbium trifluoride". Cention N Liquid contains dimethacrylates, initiators, stabilizers and additives [8]. Cention N Powder contains calcium fluoro-silicate glass, barium glass, calcium-barium-aluminium fluoro-silicate glass, iso-fillers, ytterbium trifluoride, initiators and pigments. Alkasite resin composite contains 78.4 wt%, or 57.6 vol% of inorganic fillers [8]. The particle size of the inorganic filler's ranges between 0.1 and 7 µm. various studies conducted on this alkasite composite resin material have found significant results in terms of its strength, marginal leakage.

The aim of this study was to evaluate the quantum of extrinsic discoloration occurring in alkasite filler containing composite resin (cention N) with that of micro-hybrid composite resin (Te-econom-plus) when subjected to Tea (camelia sinensis) for a specific period of time.

Investigation have been done, whether the regular consumption of Tea may have any potent color changes, that might affect the esthetics of the tooth when alkasite composite resin (Cention N) is used as an anterior restorative material.

Hence, the specimens of microhybrid composite and alkasite composite resin were immersed in tea and distilled water and dipped for 20 mins once a day every 24 hrs. for 10 days into the Tea solution.

The specimen was then bleached with carbamide peroxide at 17%, the color specimen was measured by the spectrophotometer according to the CIW L*a*b system [9].

The color difference h-index (DEab*) between each measurement was calculated.

Spectrometer readings was taken at 490 nm to evaluate the staining effect by tea solution which was found to be higher in alkasite composite resin samples (1.808 OD) compared to the micro hybrid composite (0.259 OD) with the p value being less than 0.01, indicating that there is a highly significant difference in optical density values between the two materials namely the Alkastite composite resin and Micro hybrid composite resin.

Other studies supporting the role of alkasite resin and composite resin are as follows;

According to study conducted by iffat nasim *et al*., (2010), evaluated the effect of two beverages—Tea and Pepsion the color stability of three different composite resins after a period of 7 and 30 days. Color stability of a microfilled, microhybrid and nanocomposite was evaluated after storage in Tea, a carbonated drink or Distilled Water for 7 and 30 days. Color measurement was done using reflectance spectrophotometer based on the CIEL*a*b* color scale. Mean values of the different groups were compared using three-way analysis of variance and multiple comparisons of the mean values were done using Tukey–Kramer test with 0.05 as significance level. Results showed: All tested resin composites showed color change after a period of 7 and 30 days. The color change exhibited by all three groups was significantly different for all three beverages studied, at both time periods (p<0.05). Amongst the resin composites studied microhybrid composite was found to be more color stable. The microfilled composite discolored most in Distilled Water and Pepsi at the 7th and 30th day. The nanocomposite

discolored most in Tea at 7th and 30th day [3].

According to Manpreet kaur *et al* (2019), study have been done to evaluate and compare the compressive strength of alkasite composite resin (Cention N) with Glass Ionomer cement as a restorative material. Results: Showed that alkasite composite resin (Cention N) had high compressive strength than GIC Type IX [10].

In numerous studies, it has been observed that the newly introduced alkasite composite material is superior in alternating reduced microleakage, improved strength, modulus of expansion, radiopacity and fluoride release to arrest the process of dental caries. However, studies were yet to be done to evaluate the long-term esthetic durability of the alkasite composite resin.

In this study, it was observed that the esthetic quality of the newly introduced alkasite composite resin was inferior when compared to the micro-hybrid composite resin. The probable reasons could be due to the type of filler used, size or distribution, which might have role in contributing to the refractory index, radiopacity.

Conclusion

The refractory index of silica particles (fillers of micro hybrid composite) may have impact on the esthetic potency which could be more than the fillers in alkasite composite resin. Hence further studies are required to modify the filler used in this alkasite composite resin, when esthetic becomes the prime concern for the patient. In this study, alkasite composite resin has been observed to be esthetically inferior (compared to micro hybrid composite) over a period of time, when it is subjected to staining. However, numerous studies have shown that, alkasite composite resin (when compared to dental amalgam) as a posterior restorative material has proven to have improved properties such as fluoride release, its strength, reduced micro leakage, modulus of expansion, etc.

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