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Comparative evaluation of colour stability of preheated and non heated flowable composites after periodic exposure to various spices - An vitro study

Running title: Color stability of Preheated and Non heated Flowable composites

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Abstract:

Introduction: Composite resins are among the most commonly used dental materials because of their capacity to connect with enamel and dentin, similarity to the color and mechanical characteristics of teeth, simplicity of clinical application, and affordable price. Restoration materials made of resin composite can imitate the tooth's natural color and tint. Exogenous colors from food and beverages, however, might discolor them as a result of adsorption. The aim of the study is to compare and evaluate the color stability of preheated and Non heated Flowable composites after periodic exposure to various spices.

Materials and Methods: The samples were kept in various spices solution and kept at 37 °C for 3 days, CIELab parameters were calculated. In our investigation, the spectrophotometer gadget (VITA Easy shade compact) was used to measure and evaluate the color coordinates of the samples directly, providing greater precision. One way ANOVA test was used to evaluate the data by SPSS version 23.

Result: Higher the delta E value lower is the color stability, that is delta E is inversely proportional to color stability. Preheated composites have higher delta E value so low color stability. P value 0.084 indicates that the data is statistically insignificant. On comparing both preheated and non heated composites, chili powder produced more staining than turmeric.

Conclusion: We can conclude from this research that using these common spices over time will result in the discoloration of composites in repaired teeth, and we are able to demonstrate this with the color stability studies that we have carried out.

Keywords: Flowable composite, Color stability, Spices, Novel, Preheating

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Introduction:

Globally, oral diseases have a negative impact on people's health, happiness, and quality of life. Furthermore, uncontrolled diabetes, cardiovascular disease, and respiratory disease might result from poor dental health connected to systemic bacterial and inflammatory susceptibility. Dental decay (also known as dental caries) therapy is still an essential component of routine dentistry, despite the vast breakthroughs in oral hygiene education and practice. Since 1981, dental restorative materials have included glass ionomers (13.4%), amalgams (40.9%), resin-based dental composites (44%), and various types of restoration (including indirect and temporary restorations) (1.7%). [1] In dentistry, utilizing resin-based dental composites rather than amalgam is becoming more popular. [2] Since over 50 years ago, composite resin has been used in dentistry as a restorative substance. Consumer expectations for aesthetically pleasing restorations and public anxiety over dental amalgam, which contains mercury, have led to an increase in the use of this material recently. Today, 50% of all posterior teeth direct restorations and over 95% of all anterior teeth direct restorations both use composite.[3]

Resin-based dental composite materials, sometimes referred to as "dental composite," are widely used in dentistry to provide directly attractive tooth-like restorations[4]. They are used as orthodontic appliances, veneers, crowns, endodontic sealants, pit and fissure sealants, and restorative materials in dental practices. [5]These materials consist of an inorganic/organic filler matrix and an organic resin matrix. [6]The organic resin matrix phase consists of a combination of multifunctional monomers and light-sensitive initiators, whilst the inorganic/organic filler phase contains "micro/nano-sized fillers that are primarily employed as reinforcement."[7]

In general, pre-heating composites before photoactivation reduces their viscosity, which has been proven to increase marginal adaptation and lessen microleakage since cavity walls are better moistened. [8] In addition, higher polymerization temperatures improve radical and monomer mobility, leading to higher overall conversion.[9] It has been suggested that the flow and degree of polymerization of composite materials can be increased by placing them at a higher temperature. [10]Better mechanical and physical qualities of pre-heated composites, like higher flexural and

diametral tensile strength, may result from this. [11]For composite resin restorations, good color matching and stability are essential requirements. There are two types of color changes: intrinsic and extrinsic. [12]These are brought on by the type of food consumed, the size and type of fillers, and the type of resin utilized. The food discolors the resin composites due to the adsorption and absorption processes on their surface. [13]The discoloration is influenced by the composite resin matrix's compatibility and pH. The aim of the study is to compare and evaluate colour stability of preheated and non heated flowable composites after periodic exposure to various spices.

Materials And Methods:

This investigation used two nanohybrid resin composites in the A2 shade, one preheated using a composite warmer and the other not heated. Using a stainless template mould, twenty cylindrical samples, each measuring 5 mm by 3 mm, of each resin composite were made. To create a smooth, level surface and avoid air bubbles, the material was placed into the template, which was sandwiched between two glass plates covered in mylar matrices. After that, it was subjected to an LED light source with a wavelength of 1000 mW/cm 2 for 20 seconds on each side.

To ensure a consistent distance between the samples and the light source, the tip of the curing unit was positioned directly above a glass slide that had a thickness of 2 mm. After that, the generated samples were manually wet ground for 10 seconds in one direction on one side using silicon carbide abrasive with a grit of 1000. They were polished on just one side using the Shofu Super-Snap Mini Kit composite polishing kit, which progressed from coarse to fine discs.

The samples were stored in distilled water prior to baseline color value evaluation using a spectrophotometer (Vita Easy shade compact spectrophotometer). The samples were placed on the spectrophotometer slot table against a white backdrop, and the baseline l* a*b values were recorded. The Commission Internationale d'Eclairage developed the CIE lab system to classify colors based on how people see them. The amount of light reflected by the selected colors is measured. On a white backdrop, a standard illuminant was used for this.

A 0.1% solution of turmeric and chilly powder was made with distilled water. The resin samples were immersed for 21 days in the test solutions; Group A – Turmeric immersion - preheated

composite [n = 5]; Group B – Chilly powder - preheated composite [n = 5]; Group C – Turmeric powder - non heated composite [n = 5]; Group D – Chilly powder - non heated composite [n = 5]. Daily changes were made to the solutions, and they were occasionally stirred. Following a 21-day immersion period, the samples underwent another colorimeter test to assess any changes in color values. For every sample, an average of three repeat readings were acquired. The formula was used to calculate the color difference (ΔE*ab) before and after immersion. $\Delta E^*ab = ([\Delta L]2 + [a]2 + [b]2)1/2$.

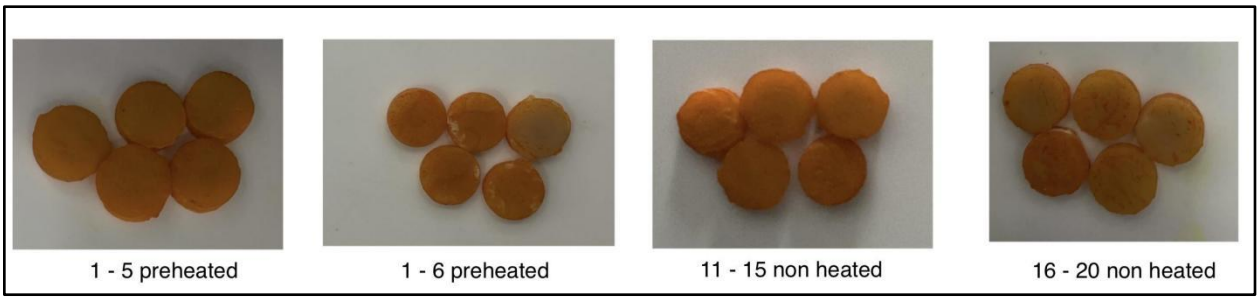

Figure 1: Shows the stained preheated and non heated composite resins

Results:

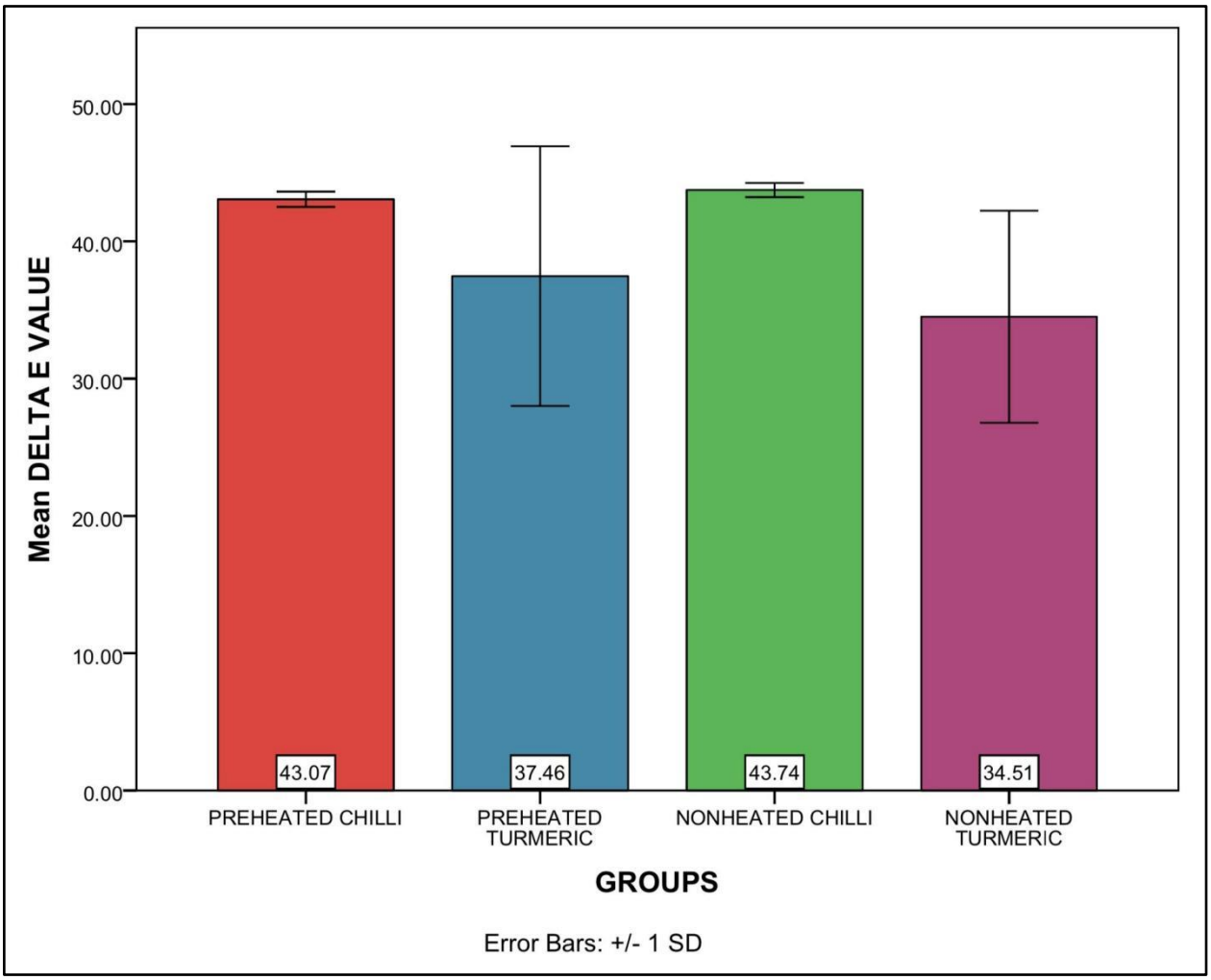

Figure 2: Represents the color stability values of the groups

Statistical analysis was done using SPSS version 23 and one way Anova test was done. From the above graph we are able to interpret that preheated as well as non heated composites which were suspended with turmeric solution had better color stability property than the composites which were treated with chili powder solution. Higher the tan delta value lesser is the color stability. Preheated and non heated chili recorded higher tan delta value so their color stability is poor. Preheated and non heated composites with turmeric solution had lesser tan delta value so higher is the color stability. P value=0.084, indicates that the data is statistically insignificant.

Discussion:

Numerous factors, including dental plaque buildup, food coloring stains, dehydration, and the oxidation of unreacted carbon double bonds, can cause external discolouration. [14]The compatibility of the pigments with the resin matrix determines how well the pigments absorb into the composite resins. Micronutrients known as polyphenols are widely distributed in the food, particularly in Indian spices. [15]Teeth become stained as a result. A broad range of chemical substances with one or more phenol units that are present in plants are called polyphenols. [16]Six-membered aromatic hydrocarbon rings joined straight to a hydroxyl group make up a phenol unit. Acidic chemicals, such as polyphenolic compounds, cause the hydroxyl group to release hydrogen ions.[17] The current study assessed how easily pre heated and non heated nanohybrid resin composites may be stained by Indian spices and food colorings. [18]Composite resins, according to Bagheri et al., can absorb water and other liquids as well, which causes discoloration and a decrease in mechanical capabilities because of polymer matrix degradation. [19]According to the study's findings, chili powder stained resin composites more intensely than turmeric did. Turmeric known as the "golden spice of India," turmeric has been used for centuries. Turmeric's yellow hue is attributed to curcumin, the main polyphenolic/curcuminoid molecule. Thirteen Flavonoids, ascorbic acid, and polyphenols are highly concentrated in turmeric.[20]

After being submerged in turmeric solution for 21 days, the resin samples produced a color difference (E) that was significantly larger than the threshold considered clinically acceptable. [21]Comparing the difference to the other study solutions revealed that it was statistically significant. [22]This is consistent with research using indigenous spices, where it was discovered that turmeric stained resin-based composites more than tobacco, tamarind, or paprika. Whereas in our study we found chili powder to stain preheated and non heated composites at a greater amount than turmeric.

Colors are typically added to polymers like polymethyl methacrylate using dyes and pigments. The nature of the materials used in a composite has a significant impact on its ability to absorb fluids. The primary mode of fluid absorption in resin matrix is direct absorption. Organic pigments that are in the yellow, orange, and red color ranges, such as azo pigments, are quite compatible with polymer. [23]Organic pigments include curcumin from turmeric. Hydrophobic materials, which lack hydroxyl groups in their composition, exhibit low water sorption but are stained by

hydrophobic solutions, whereas hydrophilic materials, which have high water sorption, are stained by hydrophilic substances in aqueous solutions. Curcumin in turmeric are hydrophobic because they are polyphenols, which are nonpolar in nature. According to earlier studies, highly polar colorant solutions like coffee and tea initially leach out and discolor the resin matrix. Through adsorption and absorption, they discolor the resin's surface or permeate the resin.[24] However, since polarity of the material may not be the mechanism causing discolouration with these substances, curcumin and carotenoids are polyphenols that are not polar. Instead, it is likely that these colorants diffuse as discrete phases into the resin matrix, discoloring the resin. In earlier studies when compared to curcumin, carotenoids from tobacco and tamarind are seen to color the resin monomer to a lesser amount. Whereas in our study we noticed chili stained composites to a higher amount than turmeric. Further research is needed to fully understand the origin of chili powder's dark, strong hue, which contains certain polyphenol compounds which contributes to the property of staining the surfaces of composites.

Conclusion:

Indian spices have a tendency to discolor both the preheated and non heated composites. As a result, patients should be informed that certain spices may cause discolouration. Compared to turmeric, chili powder caused excessive stain on both preheated and non heated composites. Further studies are needed to find out the proper mechanism for staining of composites at a higher rate by chili powder.

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Conflict of Interest:

The authors hereby declare that there is no conflict of interest in this study.

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