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Comparative Evaluation Of Natural Tooth Whitening Agents - An In vitro Study

Research Article

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Abstract

Introduction: This study aims to evaluate the colour change in the human enamel bleached with two different natural products and carbamide peroxide, using spectrophotometer.
Materials and Methods: Freshly extracted 60 single rooted teeth were obtained. The specimens were divided in to three groups of 20 each: Group 1- Carbamide Peroxide, Group 2- Activated Charcoal, Group 3- Strawberry Puree. These teeth were treated with their respective groups for 20 mins, three times for 1 week. Before and after treatment readings were evaluated.
Results: Data were analysed using one way ANOVA followed by Dunnett's T3 post hoc test for intergroup comparison. The results showed that carbamide peroxide was significantly different from activated charcoal ($p<0.01$) and strawberry puree ($p<0.01$). Activated charcoal and strawberry puree showed better results in tooth whitening. These natural products can also be used for tooth whitening.

Keywords: Bleaching; Charcoal; Fruit Extract; Natural; Tooth Whitening.

Introduction

In recent years aesthetic appearance has become the public concern including the orofacial appearances for social, psychological, occupational and for other reasons. The beautiful teeth are very influential for individual appearances because the teeth are the most prominent element when someone is smiling, talking or laughing. Tooth whitenting has now become more common and patient preferred procedure. Any abnormalities of tooth can diminish the beauty of a smile in the form of malposition and discolouration [1, 3].

Delivering of bright beautiful smile becomes a part of treatment protocol of such procedures. These procedures would include from bleaching to restorations and veneers [4, 7]. As bleaching is the most conservative procedure, this vital bleaching has gained a lot of popularity. Though various new agents and techniques have been developed in the market for vital bleaching, most of the agents commonly consist of hydrogen peroxide and carbamide peroxide either in office and at home to achieve the better results [8].

Although hydrogen peroxide gives the better results, clinically it has few disadvantages. These causes changes in surface texture, composition and microhardness of enamel [9, 12]. So many studies are undertaken to reduce the effect of hydrogen peroxide by decreasing its concentration. For in-office dental bleaching some clinicians recommend 35% concentration of hydrogen peroxide, which is to be followed by at-home bleaching with gels of 15% or 20% carbamide peroxide [13, 15]. This showed that higher concentration bleaching agents can produce more peroxide radicals for bleaching, resulting in faster whitening process. However this rapid process may increase the side effects like gingival irritation, tooth sensitivity, throat irritation and nausea [16, 17].

Over the counter(OTC) bleaching products composed of low

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concentrations of whitening agent (3-6% hydrogen peroxide) and can be self applied to the teeth through gum shields, strips or paint on product formats [18, 19]. This is supposed to be used twice a day for two weeks. However the safety of these products are questionable and few are not regulated by Food and Drug Administration.

These bleaching agents have disadvantages like soft tissue burns, turning the tissue white in case of powerful in-office bleaching (30-35% hydrogen peroxide), gastrointestinal mucosal irritation [20, 23]. Other effects of bleaching include the morphological alteration of the enamel surface like demineralization and decreased protein concentration, increased porosity of superficial enamel structure, organic matrix degradation, calcium loss and modification in calcium phosphate ratio, changes in enamel surface hardness and wear resistance, changes in dentinal structures [24, 25]. It also causes changes in composite restoration, surface properties and microhardness on composite restoration, colour change, effect on marginal quality and microleakage, bonding etc [29, 30].

We have numerous highly cited publications on well designed clinical trials and lab studies [31, 47]. One of such attempts is to lower the concentration of bleaching agents. This study aims at providing a new natural products for tooth whitening like activated charcoal and strawberry puree. The aim of this study is to compare the efficacy of the natural tooth whitening agents with the conventional bleaching agent carbamide peroxide.

Materials and Methods

Specimen Collection

For this in vitro study 60 extracted single rooted teeth were collected. These teeth were cleaned of calculus and remaining soft tissue using ultrasonic scaler. The specimens were stained by full immersion of samples in a coffee solution (Nescafe) renewed every 24 hours for 3 days. At each refill of coffee solution was prepared by mixing 500 ml of boiled water with 45 gram of soluble coffee. After staining the specimens were washed under running water for 30 seconds. After staining procedure then the specimens were subjected to whitening procedures according to the respective groups.

Preparation Of Strawberry Puree

For the preparation of strawberry puree, two hundred grams of straw berries cut in to small pieces. The pieces were smashed and blended in blender. The obtained strawberry puree refrigerated at 4°C.

The teeth were randomly divided into three groups of 20 teeth each. Group I (n = 20) - 35% Carbamide peroxide (Ultradent), Group II (n = 20) - activated charcoal(Health vit), Group III (n = 20) - strawberry puree.

The specimens in each group were undergone strawberry puree, carbamide peroxide and activated charcoal application for 3hrs. After the treatment, the teeth were rinsed and stored in artificial saliva at 37°C for 24 hours.

Whitening Measurement

To measure whitening, a digital spectrophotometer was used to measure the initial colors of the specimen and the final colors after being tested with the group. The spectrophotometer measurement values were obtained.

The formula of the values of E^* was expressed as follows.

$$E^* = \{(\Delta L^*)2 + (\Delta a^*)2 + (\Delta b^*)2\}1/2$$

where, E^* was the value of color change of the test specimen,
L^* was the value of the brightness of the test specimen - the brightness of the object, 0 (black) to 100 (white),
a^* was the colour of the test specimen - the value of the degree from red to green color (the closer to 0, the closer to white color),
b^* was the colour of the test specimen - the values of the degree from yellow to blue color (the closer to 0, the closer to white color).

Statistical Analysis

The results obtained were analysed statistically using one way ANOVA followed by Dunnett's T3 post hoc test for intergroup comparison. The SPSS software (version 22.0) package was used for the analysis.

Results and Discussion

The results of this in vitro study are given in table 1 and table 2.

In all the groups evaluated in the study the mean values obtained with the use of carbamide peroxide was more significant than activated charcoal and strawberry extract ($p<0.01$). On comparision within the groups, the carbamide peroxide was statistically significant from activated charcoal and strawberry extract ($P<0.01$). When comparing activated charcoal and strawberry extract, activated charcoal was not statistically significant ($p<0.05$).

In this study the conventional carbamide peroxide found to be better than other natural product groups. Among the comparison between the groups, charcoal found to be effective in tooth whitening comparing it with strawberry puree. This tooth whitening effect of activated charcoal is because it is an highly absorbent substance. It usually adheres to the toxins and removes the stains, toxins etc. It also alters the PH and effective in killing the bacteria in the mouth.

The whitening effect of strawberry is due to the presence of malic acid, which acts as a natural astringent to remove surface discolouration. The ellagic acid content in strawberry is ranging from 0.43 to 4.64 mg/g dry weight. The more amount of ellagic acid will produce more potential OH clusters as a powerful oxidizer thus make the more effective bleaching process.

Ellagic acid releases the OH and H radicals which will react with the tooth enamel organic molecules and disrupt the electron conjugation, as well as changing the energy absorption in the tooth enamel organic molecules to form smaller organic molecules with a lighter colour. Ellagic acid has a OH cluster, not COOH cluster like any other acids. The electronegativity of the OH group will

Table 1: Table shows the Mean+SD before and after whitening procedures in all groups.

Treatment Groups	Whitening degree
Carbamide peroxide	8.11 ± 1.1
Activated charcoal	4.84 ± 0.46
Strawberry extract	3.97 ± 0.82

Table 2: Statistical interpretation between groups.

Groups	P Value	Significant
Group 1 vs Group 11	0.01	Significant
Group 1 vs Group 111	0.01	Significant
Group 11 vs Group 111	0.05	Significant

be easier to break and react with the organic molecules of tooth enamel.

SR Kwon et al, demonstrated the effect of strawberry mix with baking soda with other groups of citric acid, carbamide peroxide, hydrogen peroxide, home whitening, office whitening, positive and negative control, is not as effective as professionally applied bleaching agent [48].

Stephanie et al, demonstrated the teeth whitening effect of apple juice and strawberry juice in in-vitro studies, where strawberry juice was more effective in tooth whitening than apple juice [48, 49].

Conclusion

Within the limitations of this study, the tooth whitening effect is more in carbamide peroxide, activated charcoal and strawberry puree. It is concluded that natural products like charcoal and strawberry puree also promotes tooth whitening. Further studies have to be carried out with incorporation of few elements with these natural products which may further increase the efficiency of tooth whitening without harmful effects.

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