Clinical Imaging and Case Reports (ISSN 2770-9205)

New Generation of Nanozyme Based-Tooth Bleaching Gel with Dual Effect: Tooth Whitening and Enamel Microhardness Improving

Samira Jafari

Corresponding author

Samira Jafari,
Pharmaceutical Sciences Research Center, Health Institute, Kermanshah University of Medical Sciences, Iran

Received Date: August 03 2023
Accepted Date: August 05 2023
Published Date: Sep 05 2023

Abstract

Teeth discolouration is one of the most common aesthetic issues caused by inherent or external factors. Patients with severe discolorations may find the bleaching process to be an effective treatment, which can result in an immediate alteration in the colour of their teeth. According to a review of the literature, using commercial products can reduce enamel microhardness because of their high hydrogen peroxide concentration. In light of these problems, the goal of the current scenario is to develop unique, three-component dental bleaching solutions based on Cerium Oxide (CeO2) nanozyme that have a dual influence on teeth whitening and augmentation of the microhardness of the enamel. This system is divided into three parts: whitening gel (which contains H2O2), activator gel (which contains CeO2 nanozyme), and supplemental gel (i.e. gel includes hydroxyapatite). On the The synthetic whitening technique has been shown in in vitro and clinical trials to be able to both whiten discoloured teeth and increase microhardness. It's interesting to note that the clinical case reports for the current study show a striking improvement in tooth colour after using the ready-made in-office whitening dental gel.

Introduction

One of the most common approaches in the field of dentistry is aesthetic dentistry, which aims to create a beautiful smile to enhance facial aesthetics and increase the quality of social life.The colour of teeth can be taken into consideration as a determining factor in the creation of a beautiful smile, in addition to shape, size, and tooth alignment [1].The public's desire for a whiter, more attractive smile increases when teeth are discoloured, whether due to congenital conditions, diet, smoking, coloured beverages (such as coffee, tea, red wine, and others), or certain medications (such as doxycycline, tetracycline, fluoride, and others) [2].According to a review of the literature, one of the most effective ways to lighten teeth is by using dental bleaching gel based on hydrogen/carbamid peroxide.the common dental aesthetic techniques that are performed both in-office (with a high concentration of hydrogen peroxide, 35%–38%) and at home (with a low concentration of hydrogen peroxide on a dentist's prescription, 5%–22%) [3] are available at reasonable costs. It has been proven that office bleaching gels are more effective than those used at home due to their high peroxide content and laser light activation. The "gold standard" for teeth whitening often involves overnight use of custom-fitted trays and 10% carbamide peroxide. The common reasons for wanting in-office systems that use a laser light and whitening trays are certain patients' resistance to using them and the time-consuming nature of the process [4]. For the first time, this trajectory was presented.1918, by Abbot.

Several commercial items have been introduced in the cosmeticdental market up to this point [5]. These systems work by allowing bleaching agents to enter enamel nanopores with a diameter of 2 mm to 6 nm. When enamel comes into touch with these agents, this could cause the production of free radicals, which can then oxidise coloured organic molecules to remove stains from teeth [6].A class of nanoparticulate materials known as nanozymes, or nanostructured artificial enzymes, can imitate the catalytic activations of natural enzymes. Many distinct nanozymes have been reported to be used in a number of disciplines in the last ten years, particularly in the biomedical age [7]. Although though the usage of bleaching gels, particularly in dental clinics, is expanding, various research [8–10] have shown that these gels have detrimental effects on the enamel microhardness. Therefore, the development of an effective bleaching gel capable of improving tooth colour and increasing enamel microhardness is a difficult problem for researchers in the field of aesthetic dentistry.In light of these problems, this scenario suggests a new generation of bleaching systems made up of three distinct components: 1) gel - Medtext Publishing, 2022. Toutes droits réservés. Specifically, 039 contains hydrogen peroxide as the bleaching agent, cerium oxide nanozyme as

the activator gel, and hydroxyapatite and sodium fluoride as the supplemental gel.

Discussion

By FTIR analysis, the functional groups in the HAp and CeO2 nanozymes were identified, as shown in Figures 1 and 2, respectively. At approximately 1043.61 cm-1 (phosphate groups), 3642.97 cm-1 (hydroxyl groups), and 1474.15 cm-1 (hydroxyl groups), characteristic absorption peaks for HAp were seen (carbonyl groups).Absorbance bands at 3410 cm-1 and 500 cm-1 were seen in the CeO2 spectra; the former confirmed the presence of the O-H group, while the latter indicated the presence of the Ce-O group.Table S1 shows the colour variations of the bleached teeth using the chosen commercial (BOOST and FGM brands) and synthetic gels. As can be seen, the treated teeth from coffee and tea had a shade value of A3. Yet, this value changed to a lighter type in Vita shade tabs after bleaching with the investigated gels.Based on the data collected, it was discovered that, out of 8 specimens, the synthetic gel's whitening performance was comparable to BOOST brand in 5 specimens, superior to BOOST brand in 1, and weaker in 2 specimens compared to BOOST brand in 2. Also, in all treated specimens, the synthetic gel's whitening efficacy outperformed that of the FGM brand.Two women (27 and 32 years old) who were willing participants were not happy with the way their front teeth looked when they smiled widely. Volunteers were made aware of the advantages and potential hazards associated with the created bleaching gel prior to their participation in the current study.

Dental bleaching was done on participants' teeth after they signed an informed consent form.Using the Vita Classical Shade Guide from Vita Zahnfabric in Bad Säckingen, Germany, the original shade of the teeth was recorded as B1 prior to bleaching therapy. The organic contaminants were then removed from the surface crown using pumice powder. It should be highlighted that sealing the soft tissue before bleaching using lightcuring is important since peroxide chemicals can irritate the soft tissues.As a gum protector at the marginal border, soft composite resin (Smart Block, SBI nv., Herzele, Belgium) is used. The subsequent procedure involved applying the prepared gel to the teeth's surface and exposing them to a brand- and country-specific laser light for 20 seconds on each tooth. Figure 4 shows the dental images of the first volunteer, a 32-year-old lady, both before and after bleaching.This participant's tooth colour greatly improved and was scored as A1.All pre-bleaching procedures were carried out for the second candidate in the same manner as they were for the first volunteer.According to this graph, this volunteer's natural tooth colour was A35, but a single bleaching procedure transformed the colour of her teeth to A1 using the Vita Classical Shade Guide. It is noteworthy that neither of the two participants showed any signs of sensitivity or pain (the informed consent forms for both volunteers are included in Supplemental Files S5 and S6).

Conclusions

CeO2 nanozyme was used in this study to create the activator gel for the de novo bleaching system design. The increase in enamel microhardness was probably brought on by the preparation of the bleaching system with the addition of supplemental gel containing HAp nanoparticles. Furthermore, the three-component whitening approach I developed for this study does not adversely affect the efficiency of dental bleaching performed in-office.

References

1. Ahmad I. Synaesthetic restorations: a psychological perspective for surpassing aesthetic dentistry. Pract Proced Aesthet Dent. 2002;14(8):643-9;quiz 650.

2. Kaewpinta A, Khongkhunthian S, Chaijareenont P, Okonogin S. Tooth whitening efficacy of pigmented rice gels containing carbamide peroxide. Drug Discov Ther. 2018;12(3):126-32.

3. Buchalla W, Attin T. External bleaching therapy with activation by heat, light or laser-a systematic review. Dent Mater. 2007;23(5):586-96.

4. Auschill TM, Hellwig E, Schmidale S, Sculean A, Arweiler NB. Efficacy, side-effects and patients' acceptance of different bleaching techniques (OTC, in-office, at-home). Oper Dent. 2005;30(2):156-63.

5. Fasanaro TS. Bleaching teeth: history, chemicals, and methods used for common tooth discolorations. J Esthet Dent. 1992;4(3):71-8.

6. Torres CRG, Wiegand A, Sener B, Attin T. Influence of chemical activation of a 35% hydrogen peroxide bleaching gel on its penetration and efficacy--in vitro study. J Dent. 2010;38(10):838-46.

7. Jiang D, Ni D, Rosenkrans ZT, Huang P, Yan X, Cai W. Nanozyme: new horizons for responsive biomedical applications. Chem Soc Rev. 2019;48(14):3683-704.

8. Grobler SR, Majeed A, Moola MH. Effect of various tooth-whitening products on enamel microhardness. SADJ. 2009;64(10):474-9.

9. Cvikl B, Lussi A, Moritz A, Flury S. Enamel surface changes after exposure to bleaching gels containing carbamide peroxide or hydrogen peroxide. Oper Dent. 2016;41(1):E39-47.

10. Majeed A, Grobler SR, Moola MH, Oberholzer TG. Effect of four over-the-counter tooth-whitening products on enamel microhardness. SADJ. 2011;66(9):412-5.

11. Jafari S, Maleki-Dizaji N, Barar J, Barzegar-Jalali M, Rameshrad M, Adibkia K.Physicochemical characterization and in vivo evaluation of triamcinolone acetonideloaded hydroxyapatite nanocomposites for treatment of rheumatoid arthritis. Colloids Surf B Biointerfaces. 2016;140:223-32.

12. Sulieman M, MacDonald E, Rees JS, Newcombe RG, Addy M. Tooth bleaching by different concentrations of carbamide peroxide and hydrogen peroxide whitening strips: an in vitro study. J Esthet Restor Dent. 2006;18(2):93-100;discussion 101.