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ORIGINAL PAPER

In vitro tooth whitening efficacy of carbamide peroxide polyelectrolyte gel and colorimetric evaluation, stability, and hydrogen peroxide release

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Abstract

We fabricate a new gel containing carbopol, anionic polyacrylamide APAM polyelectrolyte, and carbamide peroxide CP 16% and evaluate its efficacy in the whitening of discolored teeth. The prepared gel was characterized by FT-IR and XRD. Fifteen extracted human teeth were used and the initial color has been evaluated by using the Vita coloration guide and standardized pictures. The teeth were stained in coffee solution for two weeks; the color assessment of discolored teeth was performed. The teeth were divided into four groups, they were immersed in the coffee solution for a different time and applied different whitening methods. The results showed that similar whitening results for the experimental groups at the end of the 14th day. These groups gave a higher whitening effect than the control group (G0). The whitening gel was effective in the bleaching of teeth stained by coffee, particularly at the end of the 14th day. Hydrogen peroxide content was determined in vitro by titration method; release kinetics was assessed by a modified spectrophotometric technique.

Keywords Carbamide peroxide · Whitening gel · APAM polyelectrolyte · Hydrogen peroxide · Carbopol · Tooth bleaching

Introduction

Tooth discoloration can happen for several reasons; the main reason is an accumulation of pigment particles on the tooth surface. The tooth discoloration takes place at the external layer of the enamel by sticking the metallic or non-metallic stain particles on the tooth surface (Karadas and Seven 2014).

Drugs, tobacco, foods, coffee, black tea, and cola are the main materials for tooth discoloration (Kawamoto and Tsujimoto 2004; Zanetti et al. 2019). Professional teeth cleaning helps to remove the stains formed by these substances (Cortes et al. 2013). Moreover, using toothpaste to brush the teeth after every meal and washing the mouth with water after drinking coffee or tea will help to avoid surface stains (Joiner 2004; Macpherson et al. 2000). The minocycline and tetracycline antibiotics, which are used after the permanent teeth have erupted and during tooth growth respectively, have been known to discolor children's teeth (Meng et al. 2021; Soeteman et al. 2018). Additionally, certain treatment strategies, such as chemotherapy and radiation, may increase the risk of tooth discoloration (Psoter and Shope 2019; Raymond and Cook 2015). Tooth whitening history began before more than 150 years ago. In the last three decades, the demand for teeth whitening has increased as esthetic dental treatments (Busenhart et al. 2018). The dental use of carbamide peroxide (CP) and hydrogen peroxide (HP), the essential fixing in all tooth brightening items, has been reported for more than 80 years (Mokhlis et al. 2000).

Hydrogen peroxide prevents and delays the growth of anaerobic bacteria colonies; therefore, it has been used for wound healing and periodontal treatment (Demarco et al. 2009; Parreiras et al. 2018). Although some rinses are simply antiseptic and aim to reduce the microbial load in the mouth or eliminate halitosis, others have unique properties that aid in stain removal while patients swish the liquid around (Gasparri et al. 2018; Zantner et al. 2007). Moreover, many types of mouthwash contain hydrogen peroxide, which permeates the tooth and breaks down the chromophore bonds. The evidence to support the efficacy of whitening

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