

# Preparation and Kinetics Releasing Study Tooth Whitening Films Containing Hydrogen Peroxide

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## **Abstract:**

The aim of this paper is to prepare a hydrogen peroxide gel for teeth whitening . The whitening product consists of a thin flexible films coated with an adhesive hydrogen peroxide whitening gel . The film is such that dissolution occurs over a period of time ranging from about 30mint. We have also determined the kinetics of hydrogen peroxide in a bleaching gel film. The material used in this study was(7.8 %) hydrogen peroxide and the study involved( 10 ) subjects , each subject ware the film with five different times on separate days. Evaluation of remaining amount of hydrogen peroxide was calculated by the method stated in US Pharmacopoeia. The study results indicate that the mean percentage of hydrogen peroxide recovered for 5, 10, 30, 45 and 60 minutes was 61, 54, 42, 37 and 32, respectively .

**Introduction :**

The dental use of hydrogen peroxide, the basic ingredient in all tooth whitening products, has been documented for over 80 years. Initially, hydrogen peroxide was used for periodontal treatment and wound healing, because it was proven to prevent and retard the colonization and multiplication of anaerobic bacteria.<sup>(1,2)</sup>

In 1966, Schneider et al.<sup>(3)</sup> documented the use of a peroxide-containing gingival strip to apply peroxides in periodontal tissue healing. It wasn't long before an accidental side effect was observed - peroxide actually whitened the teeth.

Later, a pediatric dentist, Dr. Jerry Wagner, used Proxigel in custom-fitted, vacuum-formed trays specifically for whitening teeth. These were FDA-approved oral antiseptics containing 10% carbamide peroxide.<sup>(4)</sup> The concept of tooth whitening was born.

Hydrogen peroxide releases the oxygen that breaks down the conjugated bonds in protein chains (stains) into a single bond, which increases the absorption of colour wavelengths resulting in the reflection of little colour (i.e. a whitening effect).<sup>(5)</sup> Extrinsic staining, which affects only the enamel surface, can be caused by tea, coffee, nicotine, chewing tobacco, blueberries, wine and natural aging. These stains are all relatively easy to treat with tooth whitening. The intrinsic stains that discolour the internal aspect of the tooth such as fluorosis, tetracycline, trauma, and systemic conditions are infinitely more difficult to treat.

Even though peroxides in whitening materials have been shown to permeate intact enamel in just a few seconds<sup>(6)</sup>, changing the colour of the dentin requires long exposure to realize positive results.

The safety of using hydrogen peroxide and carbamide peroxide has been documented in numerous studies. In a retrospective look at two hundred and fifty-six major medical and dental journals Yarborough<sup>(7)</sup> states that \_the safety and efficacy of hydrogen peroxide is well established.\_

Studies on the effect of hydrogen peroxide on the oral hard tissues and pulp have shown that hydrogen peroxide does not adversely affect enamel morphology or microhardness and hydrogen peroxide is not expected to inhibit pulpal enzymes<sup>(8)</sup> Even when used for extended periods of time when treating tetracycline-stained teeth, no adverse effects have been noted using carbamide peroxide.<sup>(9)</sup>

In March of 1989, Dr. Harald Heymann and Van Haywood introduced the concept of tooth whitening using a nightguard with a viscous gel containing a thickening agent (Carbopol), which allowed for longer bleach activation and increased retention in the tray.<sup>(10)</sup>

In 1989, Dr. Dan Fischer, who created Opalescence carbamide peroxide (UltraDent), received a patent for creating the thick and sticky whitening gel formulation that is still the basis for most nighttime gels marketed today. This was the first ADA-approved system for whitening.<sup>(11)</sup> This product was developed with a high water content to minimize tooth sensitivity, a neutral pH, and a thixotropic viscosity to stay in the tray. It was designed for sustained release of the hydrogen peroxide.

According to the present study there is provided a tooth . Whitening composition comprising at least one whitening agent together with at least one film forming material characterized in that composition is in the form of a film which is water soluble and or \ water dispersible .

**Materials and Methods :****Materials :**

The chemicals used in this study supplied by several sources, polyvinyl acetate was supplied by Al- Basrah office, hydroxyl ethyl cellulose,  $\text{KMnO}_4$  were supplied by Aldrich Co. , ethanol ,phosphoric acid , sorbitol , ,sulphuric acid , were supplied by Fluka Co. , hydrogen peroxide was supplied by B.D.H.Co. , distilled water was used throughout the study.

**Methods :**

Firstly, 20 g of poly vinyl acetate was dissolved in 62.7 g (95 %) ethanol with constant stirring at  $60^\circ\text{C}$  . 2.5 g of sorbitol was added as plasticizers under agitation and dissolved . Gradually 3 g of hydroxyl ethyl cellulose was added and dissolved. The solvent solution will slowly build in viscosity, 0.3 g of calcium phosphate was added as care active.

After cooling at  $25^\circ\text{C}$  , 11.5 g of aqueous hydrogen peroxide solution (35%) was added and mixed gently for about 30 min. The blended polymer solution were kept for sufficient time to remove any bubble formation and were coated onto a clean dry glass plate in dust free atmosphere at room temperature . Films after drying were removed easily from the glass plates and stored in a well closed sealed cover until use .

**Results and Discussions :**

The whitening product consists of a thin flexible film coated with an adhesive hydrogen peroxide whitening gel . The flexibility of the film is applied to the surface of the teeth and up on contact with saliva ., begins to dissolve or disperse . The film is such that dissolution occurs over a period of time ranging from about 30- 120 mint.

The film include , a polymer compound , a tooth whitening agent , an adhesive , and a plasticizer .

This study determined the kinetics release of hydrogen peroxide in a bleaching gel film .The material used in this study was(7.8 %) hydrogen

peroxide and the study involved( 10 ) subjects , each subject wore the film with five different times on separate days.

The filled film was weighed on an analytical balance sensitivity .The film was then placed into the subject's mouth and seated . Each subject wore the film with the (7.8 % ) H<sub>2</sub>O<sub>2</sub> bleaching gel on separate days , for 5, 10, 30,45 and 60 minutes .

They were provided a beaker for collecting their salivary secretions (saliva sample) . The saliva was analyzed to evaluate the amount of hydrogen peroxide each subject would probably , the bleaching agent was retrieved from : 1) the film , 2) the teeth by scraping the gel off with a spatula ( tooth sample) .

After treatment the film was carefully removed and the remaining gel was sampled from both the film and tooth surface. Both samples were analyzed .

### **Chemical Analysis :**

Hydrogen peroxide content was determined by titration with KMnO<sub>4</sub> according to procedures published in the USP (12).

Briefly, a 20-ml volume of 2.0 N H<sub>2</sub>SO<sub>4</sub> was added to a 20-ml sample, and this mixture was titrated with 0.1 N KMnO<sub>4</sub> until a slight pink color remained in the solution after addition of KMnO<sub>4</sub>.

Each ml of 0.1 N KMnO<sub>4</sub> is equivalent to 1.7005 mg H<sub>2</sub>O<sub>2</sub>, and the following formula was used to determine peroxide content:

$$\% \text{ H}_2\text{O}_2 = (\text{ml KMnO}_4 \text{ titrant}) \times 0.1 \text{ N} \times 1.7005 \text{ mg H}_2\text{O}_2 / \text{sample weight(g)}$$

The amount of hydrogen peroxide (HP) recovered in milligrams of HP present in the recovered sample was calculated using the following formula:

$$\text{Amount of HP} = V (0.1) (1.7005)$$

V = the volume of KMnO<sub>4</sub> (ml) .

The concentration of recovered gel was determined by calculating the percentage of total physical amount of gel recovered from the film and rinse samples compared to the initial amount of gel delivered .

$$\text{Con of HP at time} = (\text{total gel recovered} / \text{Initial gel delivered}) \times 100$$

The kinetics of hydrogen peroxide with each time was calculated from the ratio :

$$(\text{Con. of HP } (t) / \text{Initial con. of HP } ) \times 100$$

The initial concentration of bleaching gels was analyzed in triplicate by testing both pretreatment and post- treatment to determine the amount of hydrogen peroxide percentage at those times .

The mean residual peroxide concentrations on the film and the tooth surface are summarized in (Figure 1) and (Table1). The peroxide level on the film was initially 7.8% and decreased to 5.8% at 5 minutes ,4.02% at 30 minutes , 3.40 % at 45 minutes and 2.90 % at 60 minutes.

The peroxide on the tooth surface was initially 7.8 % and decreased to 4.67 % at 5 minutes ,2.49 % at 30 minutes , 1. 91% at 45minutes and 1.40 % at 60 minutes . Salivary hydrogen peroxide levels increased over time and the medium value were not above 0.024% hydrogen peroxide .

The total percentage of HP recovered (Figure 2) at 5, 10, 30,45, and 60 minutes was61, 54, 42, 37 and 32, respectively .

Table (1) The mean residual peroxide concentrations on the film and the tooth surface

Sample	Time (Min)	Weight (g)	V KMnO <sub>4</sub> (ml)	% H <sub>2</sub> O <sub>2</sub>
<b>Film</b>	5	0.1138	3.88	5.80
	10	0.109	3.14	4.90
	30	0.107	2.51	4.02
	45	0.090	1.80	3.41
	60	0.070	1.20	2.90
<b>Tooth surface</b>	5	0.104	2.85	4.67
	10	0.090	2.10	3.80
	30	0.113	1.65	2.49
	45	0.087	0.98	1.91

60      0.054      0.44      1.40

**Initially H<sub>2</sub>O<sub>2</sub>**      0.027      1.23      7.80



Figure 1- Peroxide concentration on film and tooth surface

Figure 2- Total percentage of hydrogen peroxide recovered

A whitening benefit is usually evident within a few days of using the whitening-film system. 10 case studies using the whitening films twice a day produced improvements in 14 days. Figures 3A and 3B depict the response after use whitening-film system improvement in intrinsic tooth color.

Figure3A\_Before treatment



Figure 3B\_Two-week after of treatment



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