

## Specific concentration evaluation of 16% carbamide peroxide compounded at dispensing pharmacies

Avaliação da concentração específica do peróxido de carbamida a 16% produzido em farmácias de manipulação

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**Abstract:** The aim of this work was to evaluate the concentration of carbamide peroxide compounded at different dispensing pharmacies. Immediate concentration analysis was made of bleaching gels dispensed by specialized pharmacies, and of a commercially available gel (control group) (n = 20). The carbamide peroxide concentration was determined by titration and the results were analyzed statistically by the Kruskal-Wallis test. The commercial bleaching agent (control group) and one of the gels from the pharmacies presented the best mean concentration values, close to 16%. In conclusion, the concentration of the manipulated and industrialized carbamide peroxide gels presented concentration values differing from 16%.

**Descriptors:** Tooth bleaching; Peroxides; Pharmacies.

**Resumo:** O objetivo deste trabalho foi avaliar a concentração do peróxido de carbamida manipulado em diferentes farmácias de manipulação. Foram utilizados géis clareadores manipulados em farmácias especializadas e um industrializado (grupo controle) (n = 20) com análise de concentração imediata. A concentração do peróxido de carbamida foi obtida por titulometria e os resultados foram submetidos a análise estatística pelo teste de Kruskal-Wallis. Como resultado, o agente clareador (controle) e um dos produtos manipulados em farmácia apresentaram as melhores médias de concentração, próximas a 16%. Pode-se concluir que a concentração do peróxido de carbamida manipulado e dos industrializados apresentaram valores de concentração diferentes de 16%.

**Descritores:** Clareamento de dente; Peróxidos; Farmácias.

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## Introduction

Dental bleaching is one of the esthetic treatment options available, and can be done alone or in combination with other esthetic procedures. In its many forms, bleaching is the most conservative treatment;<sup>14</sup> and is considered a less aggressive approach to obtaining esthetic or cosmetic results than methods such as veneering, crowning, or bonding.<sup>1,3,7</sup> According to Haywood<sup>6</sup> (1997), the initial success rate is about 92%. Thus, the treatment alone is able to significantly change the appearance of the teeth and the smile.<sup>6</sup>

Successful bleaching depends on the type of agent, stain etiology and the length of time that the stain has been present. As regards the efficacy of the bleaching agent, this depends on its concentration, how frequently it is applied, and how long it stays in contact with the dental surface.<sup>11</sup>

Bleaching gel concentration is the main factor for successful bleaching treatment. Matis *et al.*<sup>14</sup> (2000) and Leonard *et al.*<sup>11</sup> (1998) compared the efficacy of 10% carbamide peroxide with 15% and 16% carbamide peroxide, respectively. In both studies, the authors found that the higher concentration was more efficient than the lower concentration. However, both studies also concluded that, although the lower concentration of carbamide peroxide takes longer to whiten teeth, it eventually achieves the same result as that achieved by the higher concentrations.

Bleaching agents may be produced on an industrial scale or dispensed in specialized pharmacies. There are countless commercially available bleaching formulas, with different compositions and concentrations, made by different manufacturers.

The choice of using a dispensed or a commercially available product is influenced by the economical context of the country. In Brazil, due to the relatively high cost of commercial products, some dentists choose the dispensed products to reduce the costs of bleaching procedures. Bleaching agents dispensed by pharmacies should not be considered a problem, provided that their gels have appropriate consistency, concentration and composition of the active principles, as well as inert excipients for the proposed purpose.

The concentration of dispensed and of commer-

cial bleaching agents must be evaluated. Therefore, the objective of this study was to analyze the concentration of carbamide peroxide bleaching agents (16%) prepared by dispensing pharmacies and that of a commercially available product.

## Material and Methods

One hundred samples of 16% carbamide peroxide bleaching agents, both dispensed and commercially available products, were used in this study. The samples were divided into five groups (n = 20), in the following design: A, B, C and D for the different dispensing pharmacies and E for the control group (Whiteness Perfect™, FGM Prod. Odontol. Ltda., Joinville, SC, Brazil). All the pharmacies were located in Curitiba, Paraná (PR), Brazil.

The different formulations were analyzed by the Chemical Engineering Department laboratory, Pontifical Catholic University of Paraná. The tests were carried out immediately after the acceptance of material, in accordance with the US Pharmacopeia<sup>18</sup> (2000).

The carbamide peroxide concentration was determined by oxyreduction titrations. Each sample was transferred to a 250 ml Erlenmeyer flask, to which 100 ml of H<sub>2</sub>O(d) and 20 ml of glacial acetic acid were added. The acid-water mixture was stirred with a magnetic bar until completely dissolved to avoid releasing the reactive oxygen, and was then covered with aluminum foil paper. Next, two grams of solid potassium iodide were added to each sample. This salt changed the color of the samples from transparent to brown, depending on the concentration of peroxide in the sample.

One drop of ammonium molybdate was added to each reaction, causing the color to change from brown to dark brown, depending on the peroxide concentration in the sample. The solutions were placed in the dark and left there for at least 10 minutes.

Next, each sample was titrated with 0.1 N sodium tiosulphate until the color changed from dark brown to golden yellow and finally became transparent. The quantification of the oxygen released from the solution was achieved by the following equation:

$$CP\% = SV \times VCF \times 4.704 \times 100/MA$$

where:

CP: carbamide peroxide;

SV: spent volume;

VCF: volumetric correction factor of the sodium tiosulphate;

MA: mass of the sample used.

From these results, the carbamide peroxide concentrations were expressed in terms of percentage (g of peroxide/100 g of the sample). The chemical analysis was done in accordance with the method stated in the United States Pharmacopeia<sup>18</sup> (2000) and used in previous studies<sup>5,15,19</sup> to determine the amount of peroxide in each sample.

Since the carbamide peroxide concentration did not present normal distribution for each of the treatments, the non parametric Kruskal-Wallis test ( $p < 0.05$ ) was used to compare the differences between the minimal, mean and maximum percentages of carbamide peroxide concentration.

## Results

The descriptive statistic data of the carbamide peroxide concentration according to groups with immediate analysis are shown in Table 1.

The results obtained were as follows: Groups B and E had a mean concentration closer to 16% without statistical significant differences between them ( $p > 0.05$ ). Comparing these two groups, however, only the control group had a low difference between minimal and maximum concentration values.

**Table 1** - Statistical data on the observed carbamide peroxide concentration (%) according to group, with immediate analysis.

Groups	Minimum	Maximum	Mean	Standard deviation
A (n = 20)	7.80	8.40	8.14A	0.14
B (n = 20)	15.00	18.10	15.70B	0.71
C (n = 20)	18.90	21.80	20.12C	0.79
D (n = 20)	19.80	21.40	20.32C	0.43
E (n = 20)	14.03	14.80	14.34B	0.19

Distinct letters indicate mean values that are significantly different ( $p < 0.05$ ).

The mean values for the products in groups C and D did not differ ( $p > 0.05$ ), and they presented mean concentration results above the desired value. Group A differed significantly from the others ( $p < 0.05$ ), presenting the lowest mean, minimal and maximal concentration values.

## Discussion

Home bleaching treatment was more accepted by patients and professionals when compared with the in-office method because the former technique required less chair time, in spite of the in-office method being under the dentist's control and costing less. At-home bleaching is a method whereby the patient fills a custom-designed tray with bleaching material (10% to 20% carbamide peroxide).<sup>2</sup> When purchasing the bleaching agent, price might be a determining factor in the choice of the product to be applied. At that time, the consumer does not take into consideration the quality guarantee of the product to be used. This is also true when dentists choose bleaching agents dispensed by specialized pharmacies, which should not be a problem if the gel has the proper consistency, concentration and composition for clinical use.

The aim of this work was to check whether the concentration of the bleaching agents dispensed by specialized pharmacies is the same as that found in manufactured products. In this study, the methodology used to determine the concentration of carbamide peroxide in each sample was the one stated in the United States Pharmacopeia<sup>18</sup> (2000). The results obtained showed that the concentration values differed from 16%.

It is difficult to compare the results of this study with data from the literature because there are no published studies available about the real concentration of dispensed carbamide peroxide bleaching agents. Nevertheless, some authors such as Matis<sup>12,13</sup> (2000, 2003) and Al Shethri *et al.*<sup>1</sup> (2003) assessed the concentrations of industrialized bleaching agents and showed that even the industrialized products presented concentrations that differed from the desired values, being lower than those expected. This fact is, therefore, in agreement with the results of the present study, which show that the carbamide peroxide

concentrations of bleaching agents produced by dispensing pharmacies, or on an industrial scale, were different from 16%, ranging from 8.14 to 20.32%.

According to Auschill *et al.*<sup>2</sup> (2005), the higher the concentration of the bleaching agents, the faster the stain is removed. However, an increased peroxide concentration was responsible for patient complaints of tooth and gingival sensitivity.<sup>4</sup> Sensitivity may occur during the bleaching procedure and usually stops when the treatment is suspended. There is usually less gingival irritation when using an individually designed guard, as the agent has only minimal contact with soft tissue.<sup>2</sup> In the present study, the effects of these different carbamide peroxide concentrations on dentinal sensitivity, gingival irritation, speed and effectiveness of dental bleaching were not assessed.

Studies using 16.4% and 18% carbamide peroxide showed that 25% of the patients presented tooth sensitivity and 15% presented gingival sensitivity.<sup>4</sup> Some authors assessed different concentrations of bleaching agents in *in vivo* tests and the results obtained demonstrated the presence of dentinal sensitivity and gingival irritation during the bleaching procedure.<sup>9,10,16</sup> Since studies have shown that the use of peroxide may cause sensitivity and gingival irritation, the use of these products with a concentration above the desired value for a period of 14 to 21 days could result in greater dentinal sensitivity and gingival irritation.

Bleaching speed is related to the peroxide concentration<sup>8</sup> and is time dependant.<sup>17</sup> Matis *et al.*<sup>14</sup> (2000) showed that a 15% concentration resulted in a faster and greater color change than did a 10% concentration during the active treatment period in the first 2 weeks. However, at the end of their study, after 6 weeks, these differences were not statistically significant. In the above study, the effectiveness of dispensed and industrialized carbamide peroxide

products was not assessed. The results obtained in the present study revealed values lower than 16% in groups A, B and E, so the application time of these bleaching agents should probably be extended since lower concentrations of carbamide peroxide require longer application times.

Group B and the control group E presented the best mean concentrations, i.e., concentrations close to 16%. But when the maximum and minimal values were analyzed, group B achieved a maximum peroxide concentration value of 18.1% and a minimum value of 15%; in other words, values differing from those expected, even though the mean concentration was good.

Although the commercial product assessed did not achieve the highest mean concentration when compared with the dispensed products, it was the most adequate when one considers the maximum and minimum values because its concentration was the most constant one and with the smallest standard deviation (Table 1). This may be due to the presence of chemical stabilizers. Nevertheless, the concentration of this product was not the expected one of 16%, since values ranging from 14.03 to 14.80% were found.

In spite of the results achieved here, further studies are necessary as regards the real concentration of commercial brands and dispensed bleaching agents. Complementary studies about variables, such as application time and storage of the bleaching agents, are also necessary, as are studies investigating their effects on the tooth surface enamel, particularly when products are adulterated.

## Conclusion

Neither the bleaching agents prepared by dispensing pharmacies nor the industrialized product presented the expected concentration of 16%.

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