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RESEARCH ARTICLE

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Is the use of a potassium nitrate dentifrice effective in reducing tooth sensitivity related to in-office bleaching? A randomized triple-blind clinical trial

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Abstract

Objective: The aims of this study were to evaluate whether the use of a dentifrice containing 5% potassium nitrate (KNO_3) prior to and during in-office dental bleaching reduces bleaching-induced tooth sensitivity and affects bleaching efficiency.

Materials and methods: Thirty-eight individuals were randomly distributed into two groups (n = 19). The experimental group performed toothbrushing using a dentifrice containing 5% KNO_3, one week before treatment and before the first and second bleaching sessions. In the control group, a placebo dentifrice without KNO_3 was applied as described for the first group. Tooth sensitivity was recorded on visual analog scales (VAS) and numeric rating scales (NRS) immediately and up to 48 h after bleaching sessions. Color change at different time intervals, was evaluated with shade guide units (ΔSGU) and a digital spectrophotometer (ΔE CIELab 1976 and CIEDE2000) at baseline and 7, 15, and 30 days post-bleaching. Mann–Whitney test and t-test were used to evaluate TS intensity for NRS and VAS scales, respectively, and T-test was used for color difference evaluation.

Results: No significant difference in tooth sensitivity's absolute risk and intensity were observed between tested groups in any evaluated treatment time for NRS ($p = 0.91$) or VAS scales ($p = 0.48$). T-test showed no significant difference in both ΔE and ΔSGU tooth color among the experimental and control groups during the different evaluation times ($p = 0.27$).

Conclusion: The use of a dentifrice containing 5% KNO_3 does not prevent postoperatory tooth sensitivity but allows the same whitening efficiency as a regular dentifrice.

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Clinical significance: The use of a dentifrice-containing KNO_3 did not prevent bleaching-induced tooth sensitivity when high-concentrated hydrogen peroxide was used for in-office bleaching.

KEYWORDS
hydrogen peroxide, potassium nitrate, sensitivity, spectrophotometer

1 | INTRODUCTION

Dental bleaching has become a very popular treatment due to its cosmetic benefits, such as improved smile's esthetic without compromising the dental tissues.[1] Currently, because social media has a great influence on people's choices regarding their physical appearance, it is common to find patients desiring whiter teeth as white teeth are perceived to be associated with health and beauty .[2] Dental bleaching is also considered the most conservative treatment to improve dental shade, especially when compared with resin composite restorations, veneers, dental crowns, or other esthetic procedures that result in loss of tooth structure during dental preparations.[3] Due to these advantages, tooth bleaching might be considered the first choice for improving color and smile appearance.[4]

Dental bleaching can be carried out through two types of techniques: at-home or in-office bleaching.[4–6] Although both procedures promote effective tooth bleaching,[4] the selection between both types of techniques could vary according to the patients' tolerance to pain and their expectation regarding the time to obtain tangible results.[4] In this sense, patients seeking immediate results may not choose at-home bleaching to avoid the extended waiting time, which in some cases may be up to 6 weeks to achieve satisfactory outcomes.[4,7] Also, in some cases, at-home bleaching can become uncomfortable for some patients, as they may not tolerate daily use of custom-fitted bleaching trays even for short periods of time.[8] Therefore, in-office dental bleaching can be more accepted by patients, as it offers faster results, short application time and does not require custom-fitted bleaching trays.[6]

Even though at-home and in-office bleaching procedures are efficient,[4] tooth sensitivity (TS) remains as one of its main drawbacks.[9] In this regard, TS during the first stages of whitening treatment has been reported by several studies, and its prevalence can vary between 15% and 65% after at-home bleaching, and between 55% and 78% after in-office bleaching.[10–12] The higher incidence of TS after in-office techniques in comparison to that observed after at-home bleaching is directly related to the original concentration of hydrogen peroxide.[4,7,13] In this sense, TS might begin during the bleaching session, continue along the first 24 h, and rarely proceed after a 48-h period.[13]

To avoid these undesirable effects, the use of desensitizing agents has been proposed to reduce the prevalence of TS. Topical agents, such as glutaraldehyde solution, sodium fluoride, and potassium nitrate (KNO_3) have been tested for this purpose.[14–16]Among these formulations, the use of topic KNO_3 has shown promising results as a desensitizer agent during bleaching treatment, as many clinical studies have reported a reduction in TS when using KNO_3 at a low concentration (5%) prior to in-office bleaching, either when applied as a gel or in custom-fitted trays along with fluorine.[17–19] Although KNO_3 is still one of the most used products to avoid TS, it requires longer clinical sessions, at least 30 min before in-office dental bleaching.[17,19–21]

An interesting possibility is to use dentifrices containing KNO_3, mainly because, as dentifrices are over-the-counter product, it could be recommended for several days before to start the bleaching procedure. Dentifrices containing KNO_3, which possess a similar concentration (5%) to the topical gels tested in previous clinical studies, brings new treatment alternatives that could improve the undesired effects of dental bleaching.[22] Some studies showed that the use of dentifrices containing KNO_3 was useful in controlling TS in at-home techniques,[22,23] which implies that this compound may be effective in other therapies, such as in-office dental bleaching as well. Despite the encouraging results observed during at-home dental bleaching,[22,24] controversial results in terms of tooth sensitivity were observed when dentifrices containing KNO_3 were applied during in-office bleaching procedures.[25–27]

Therefore, the current clinical randomized trial study aimed to determine whether the application of a dentifrice containing KNO_3 is capable of reducing TS due to in-office dental bleaching with 35% hydrogen peroxide concentration. The hypotheses of this current study were: (1) The use of a commercially available dentifrice containing 5% KNO_3 before and during in-office dental bleaching reduces bleaching induced TS, and (2) the use of a commercially available dentifrice containing 5% KNO_3 allows the same whitening efficiency as regular dentifrice when performing in-office dental bleaching with 35% hydrogen peroxide concentration.

2 | MATERIALS AND METHODS

2.1 | Protocol and registration

This clinical trial took place in a local university in Quito, Ecuador under the review and approval of the University's Human Research Ethics Committee (evaluation report no. IR-E102-2019-CEISH-USFQ). Based on pre-established criteria, 38 volunteers from Universidad San Francisco de Quito's dental clinic were selected for this study. One week before the bleaching procedures, all the volunteers received a dental screening, a condensation silicone dental impression of the six maxillary-anterior teeth, filled in a medical history questionnaire, and signed an informed

consent form. Participants were also assigned an identification code number to protect their personal information and confidentiality.

2.2 | Study design and blinding

This was a randomized, triple-blinded, parallel clinical trial with an equal allocation rate, where the patients, operators, and evaluators were blinded to the group assignments. The operators performed the clinical interventions and evaluators assessed the sensitivity scales as well as color changes.

2.3 | Eligibility criteria

This study included individuals being over 18 years old, regardless of gender, with good dental and periodontal health. The participants were required to have six caries-free maxillary anterior teeth and without restorations on labial surfaces. Tooth shade had to be A2 or darker according to the VITA Classical (Vita Zahnfabrik, Bad Säckingen, Germany). Individuals who had undergone previous tooth-whitening procedures, had TS, were pregnant/lactating, had severe dental pigmentation caused by medications, fluorosis, or pulp disease, had pulpless teeth, were taking any type of medication (especially anti-inflammatory drugs), had wear facets, enamel cracks, gingival recession, class V injuries, dentin exposure, or any other clinical condition that could alter tooth sensitivity were excluded, as these could have interfered with the study results.

2.4 | Sample size calculation

The primary outcome of this study was absolute risk of TS. Thirty-eight participants were required to have a 90% chance of detecting a decrease in TS after bleaching sessions, a decrease in the primary outcome measure from 80% (average absolute risk of TS in the control group) to 30% in the experimental group ($\alpha = 0.05$). This sample size was calculated on the website www.sealedenvelope.com.

2.5 | Randomization and allocation concealment

A person who was not involved in any of the clinical procedures performed the randomization and allocation process to protect the trials confidentiality, by using a computer-generated table. Thirty-eight participants were divided in two groups ($n = 19$), the experimental and control group, according to the dentifrice to be used. Both dentifrices were set in separate but identical containers to blind participants, operators, and evaluators. The dentifrice delivery sequence was prepared, and each dentifrice was carefully placed into opaque and sealed envelopes, which were delivered to a third person responsible for their distribution.

2.6 | Dentifrice distribution

This was performed by a person who was not involved in the allocation concealment process. Participants received their assigned sealed envelope along with a toothbrush and an instruction sheet, which required to do a 3-min tooth brushing, three times a day, for 7 days before bleaching sessions. It was also required to do a tooth brushing 20 min before the whitening procedures. The experimental group received a commercially available dentifrice containing 5% KNO_3 (Soral-F Plus, Lamosan, Quito P, Ecuador), and the control group received a non-containing KNO_3 dentifrice (Colgate Maximum Cavity Protection Toothpaste, Colgate-Palmolive Company, United Kingdom).

2.7 | Clinical intervention

All participants received dental prophylaxis with pumice and water to remove dental biofilm. Relative isolation was applied with buccal retractors and cotton rolls, and gingival tissues were covered with a light-polymerized resin dam (Top Dam, FGM Dental Products, Joinville SC, Brazil). Both groups received 35% hydrogen peroxide gel (Whiteness HP 35%, FGM Dental Products, Joinville SC, Brazil) in three applications of 15 min each, according to the manufacturer's directions. The products were refreshed every 15 min during the 45-min application period. Afterwards, the hydrogen peroxide gel was removed using sterile gauze pads and a salivary suction cannula. The same protocol was applied for the second bleaching session after 7 days.

2.8 | Tooth sensitivity evaluation

Tooth sensitivity was evaluated in different time intervals: during bleaching treatment up to 1 h, from 1 h up to 24 h post-bleaching, and from 24 to 48 h post-bleaching (first and second session).[28] Two pain scales were provided to participants in order to record their TS perception during the first and second bleaching sessions. One scale was the visual analog scale (VAS), which is a 10-cm horizontal line scale that has the scores 0 and 10 at the ends, in which 0 corresponds to no sensitivity and 10 corresponds to severe sensitivity.[28] Participants were asked to mark a vertical line across the horizontal line of the scale to indicate their TS intensity. The other scale was the numeric, 5-point rating scale (NRS), in which participants had to record their TS experience based on scores: 0 = none sensitivity, I = mild, 2 = moderate, 3 = considerable, and 4 = severe sensitivity.[28]

2.9 | Color evaluation

Tooth color was recorded only by one examiner before the bleaching treatment and at 7, 15, and 30-day intervals after the treatment by using a visual shade guide (value-oriented shade guide VITA Classical Shade Guide, VITA Zahnfabrik, Bad Säckingen BW, Germany) and a

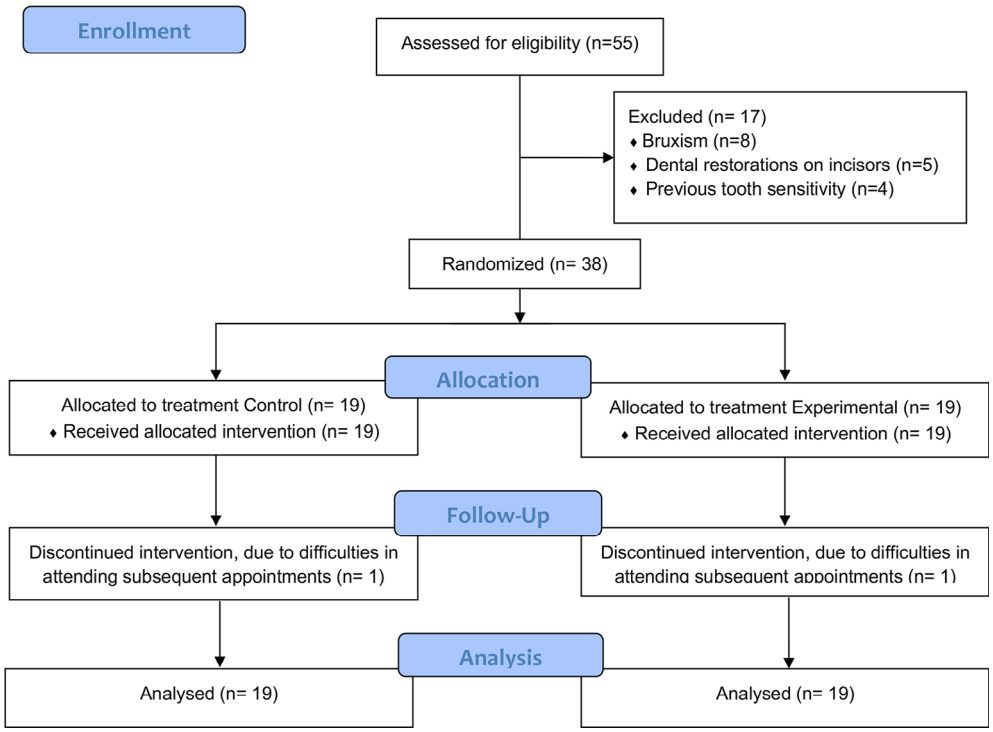

FIGURE 1 Flow diagram of study design phases including enrollment and allocation criteria

TABLE 1 Comparison of the number of patients who experienced tooth sensitivity during bleaching treatment with absolute and relative risk ([a])

	Tooth sensitivity (number of patients)			
Groups	**Yes**	**No**	**Absolute risk (95% CI)**	**Relative risk (95% CI)**
Control	17	01	94.2 (73.1–99.0)	0.52 (0.05 to 5.3)
Experimental	16	02	89.9 (67.2–96.9)	

Abbreviation: CI, confidence interval.
[a]Fisher exact test $p = 1.0$.

TABLE 2 Medians and interquartile ranges of the tooth sensitivity intensity measured by NRS, as well as means and standard deviations of the tooth sensitivity intensity measured by VAS for both groups on different evaluation time ([a])

Periods	**Numerical rating scale (NRS)**			**Visual analog scale (VAS)**			
	Medians and interquartiles intervals			**Means and SD**			
Periods	**Experimental**	**Control**	***p* value ([a])**	**Experimental**	**Control**	**Mean differences (CI 95%)**	***p* value ([b])**
Until 1 h	1.5 (0.4 to 2.5)	1.1 (0.5 to 1.8)	0.91	3.5 ± 2.7	3.0 ± 2.4	0.5 (−1.23 to 2.23)	0.75
1–24 h	1.0 (0.0 to 1.2)	1.0 (0.0 to 1.3)	1.00	2.2 ± 3.0	1.9 ± 2.1	0.3 (−1.45 to 2.05)	0.91
24–48 h	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.0)	1.00	0.5 ± 1.2	0.4 ± 1.0	0.1 (−0.65 to 0.85)	0.48

Abbreviation: CI, confidence interval.
[a]Mann–Whitney test.
[b]T-test for independent samples.

spectrophotometer (VITA EasyShade Advance, Vita Zahnfabrik, Bad Säckingen BW, Germany). The shade tabs from the VITA classical shade guide were set in descending order from the whitest to the darkest, as follows: B1, A1, B2, D2, A2, C1, C2, D4, A3, D3, B3, A3.5, B4, C3, A4, and C4.[28] All measurements were performed in the middle third of the buccal surface of the six upper-anterior teeth.

For the spectrophotometer evaluation, a dense silicone (Speedex, Coltène Whaledent AG, Altstaetten, Switzerland) was used to make a dental impression of the six maxillary-anterior teeth of the patients. A circle perforation with 3-mm diameter was created in the middle of the silicone matrix by using a spherical carbide burr to allow the access of spectrophotometer to the middle third of the buccal surface

of each upper, anterior tooth. The silicone matrix served as a guide for standard color measurement using the spectrophotometer.

Color change (ΔE) was given by the difference between baseline and each recall period, calculated by using the original CIELab (1976)[29] and also using the CIEDE2000, a formula based on the CIELab, which measures color difference and includes not only lightness, chroma, and hue weighting, but also an interactive term between chroma and hue differences for improving insight for small color differences.[30]

2.10 | Statistical analysis

The statistical analysis involved all patients following the intention to treat protocol.[31] The color changes between groups (ΔE CIELab 1976, CIEDE2000 and ΔSGU) in each time were compared using a t-test for independent samples, in which a mean value from the six maxillary teeth was used for each time interval. For the TS absolute risk, it was used the Fisher exact test. The relative risk and confidence interval were also calculated.

The TS intensity evaluated by NRS were analyzed by using the Mann–Whitney and TS intensity evaluated by VAS were analyzed by using the t-test for independent samples. In all statistical tests, the significance level was 5%. We performed all analyses by using the software SigmaPlot Version 11.0 (Systat Software).

3 | RESULTS

Fifty-five volunteers were assessed but only 38 patients were selected, according to the inclusion criteria (Figure 1). Two participants dropout during the bleaching treatment, one of each group, due to difficulties in attending subsequent dental appointments. The patients presented similar age average between groups (experimental group: 25.1 and control group: 22.4), and 88% and 73% of the patients from the experimental and control groups, respectively, were women.

3.1 | Tooth sensitivity evaluation

A total of 17 patients (absolute risk 95% CI: 94% [73%–99%]) presented TS in the control group. On the other side, 16 patients (absolute risk 95% CI: 89% [67%–96%]) reported TS in the experimental group (Table 1). In comparative terms, the relative risk for TS was 0.52 (95% CI 0.05–5.3; Table 1), and it did not show statistical significance ($p = 1.0$; Table 1).

The TS intensity reported by most patients was mild to moderate in the NRS and VAS scales for both groups (Table 2). No significant difference in the TS intensity was observed between control and experimental groups in any week of treatment for NRS ($p > 0.91$; Table 2) and VAS scale ($p > 0.48$; Table 2). Despite the higher number of patients with TS observed in both groups (Table 1), the TS significantly decreased between 24 and 48 h (Table 2).

TABLE 3 Means and SD of ΔE (CIELab 1976 and CIEDE2000) obtained with spectrophotometer Vita Easyshade, as well as ΔSGU obtained with Vita Classical for both groups on different evaluation time [a]

Tooth	7 days		Mean differences (CI 95%)	p value [a]	15 days		Mean differences (CI 95%)	p value [a]	30 days		Mean differences (CI 95%)	p value [a]
	Exp	Cont			Exp	Cont			Exp	Cont		
$\Delta E_{(1976)}$	5.5 ± 3.7	6.7 ± 3.1	−1.2 (−3.4 to 1.0)	0.46	8.7 ± 6.0	9.7 ± 3.7	−1.0 (−4.3 to 2.3)	0.27	9.9 ± 6.4	10.9 ± 3.9	−1.0 (−4.5 to 2.59)	0.69
$\Delta E_{(2000)}$	3.9 ± 2.4	4.5 ± 2.0	−0.6 (−2.0 to 0.8)	0.30	6.1 ± 4.1	6.6 ± 2.6	−0.5 (−2.7 to 1.7)	0.60	6.9 ± 4.4	7.6 ± 2.6	−0.7 (−3.1 to 1.7)	0.60
ΔSGU	2.1 ± 1.8	2.9 ± 2.5	−0.8 (−2.2 to 0.6)	0.64	2.2 ± 2.2	3.1 ± 2.3	−0.9 (−2.4 to 0.6)	0.47	2.4 ± 2.1	3.3 ± 2.2	−0.9 (−2.3 to 0.5)	0.45

Abbreviations: CI, confidence interval; $\Delta E_{(1976)}$, ΔE CIELab 1976; $\Delta E_{(2000)}$, ΔE CIEDE2000; ΔSGU, change in shade guide units.
[a]T-test for independent samples ($p < 0.05$).

3.2 | Color evaluation

The descriptive data from bleaching obtained after 7, 15, and 30 days can be seen in Table 3. No significant differences were showed between experimental and control group during the tested intervals (Table 3) according to the ΔE analysis performed with both CIELab 1976 and CIEDE2000 parameters. For ΔE CIELab 1976 and ΔE CIEDE2000, the color change was around 10 and 7 units in ΔE, respectively for both groups, which means that a significant whitening effect was observed. The same result was obtained for ΔSGU for Vita Classical guide (Table 3).

4 | DISCUSSION

In the current study, TS intensity was evaluated using two pain scales, the VAS and the NRS.[28] The results obtained from these scales revealed that no significant difference in TS was noted in patients who used a dentifrice containing 5% KNO_3 and those who used a regular dentifrice. In other words, the use of a dentifrice containing 5% KNO_3 did not reduce the TS associated with in-office dental bleaching. Therefore, the first hypothesis of this study, which established that a significant reduction in TS is observed when a dentifrice containing 5% KNO_3 is used before and during in-office dental bleaching in comparison with the use of a dentifrice without KNO_3 was refused.

The effect of KNO_3 is related to its diffusion throughout the dental structure until it reaches the pulp, due to its low-molecular weight (101.10 gr/mol), reducing the excitability of the pulp nerve through depolarization of the nerve fibers, and therefore preventing TS.[20] However, its effect depends on the sufficient potassium ions penetration into the tooth, which must reach a concentration greater than 8 mM-16 mM (0.08–0.16% as KNO_3) around the axons, in order to maintain nerve depolarization and block pain transmission.[32] Therefore, factors such as application time, dentifrices formulation, and KNO_3 viscosity could predict its performance as a desensitizing agent.[20]

In the present study, a dentifrice containing KNO_3 was used as a therapeutic agent for 3 min, three times a day, during 7 days before the first and second bleaching sessions. Such protocol was based on previous studies that recommended a 2–3 min toothbrush repeated two to three times per day.[20,33–35] In this context, previous studies revealed that KNO_3 penetration into the pulp cavity is time dependent.[20] In other words, the longer the duration of its application, the higher the concentration of KNO_3 within the pulp chamber, so a better desensitizing effect will be achieved.[20] Indeed, it is known that KNO_3 requires application period ranging between 5 and 30 min to reach the pulp chamber.[20,21,23] However, tooth brushing for these periods is clinically unfeasible. In this sense, the brushing time evaluated in the current study may have not been enough to allow KNO_3 to act as a desensitizer agent due to the high concentrations of hydrogen peroxide that penetrates the tooth structure during in-office dental bleaching. In this regard, the brushing time and the high concentrations of hydrogen peroxide also help explain the contrast between the current findings and those from other studies that observed a positive desensitizing effect of dentifrices containing KNO_3 during and after at-home dental bleaching treatments,[22] which use lower concentrations than in-office products.

The influence of dentifrice formulation on the effectiveness of KNO_3 should not be discarded. More specifically, because the viscosity of vehicles and thickeners can hinder the movement of KNO_3 molecules,[20] the diffusion rate of KNO_3 within the dentin tubules might be impaired by products containing more viscous vehicles.[20] Traditionally, bleaching sensitivity management includes the application of KNO_3 desensitizing gels by using custom trays for 10–30 min, before or after dental bleaching.[20,21,23] Similarly, some manufacturers claim that the incorporation of KNO_3 in bleaching products formulations would prevent TS, although controversial results in terms of risk of postoperative sensitivity has been noticed in comparison to when commercial products without this active ingredient were applied.[36,37] According to previous studies, the addition of KNO_3 in those products increased the bleaching gel viscosity even more, which in turn slowed down the KNO_3 inward diffusion to the pulp.[19,36] These findings reinforce the evidence that the mechanisms of how potassium salts are applied, their presentation form, and vehicles could influence their desensitizing therapeutic effect. Further studies analyzing these variables are required to provide more information regarding their effects.

Another important aspect that could help explain the findings observed in the present study is the transitory and reversible effect of potassium salts on nerve excitability.[17] A previous study showed that the desensitizing effect of potassium ions decreases after a 5-min application due to the drop of potassium concentration around the nerve axons.[20] Therefore, even though tooth brushing was performed three times a day, the time lapse between brushing may have allowed a decrease in the concentration of potassium ions and their desensitizing effect as a consequence. In addition, some authors have argued against potassium tubule diffusion and tissue lability,[35] as they stated that the potassium salts would have to penetrate several millimeters against dentinal fluid flow to reach the pulp, as well as describing potassium's incapability to accumulate within the pulp. In this sense, potassium ions would be likely to diffuse away from dentine and into saliva, gingival or mucous membranes during tooth brushing.[35] Hence, due to these transitory and reversible characteristics, a longer application period is important in producing a more sustained desensitizing effect as KNO_3 is time dependent.[20] However, performing a prolonged tooth brushing is likely to be unviable.

Differently from the results found in the current study, other studies reported that the use of a dentifrice containing 5% KNO_3 prior to at-home dental bleaching reduced TS significantly.[22,27] It is worth noticing that differently from the current study, Alencar and colleagues[22] evaluated a 22% carbamide peroxide, while a 35% hydrogen peroxide was tested in the present study. Because the initial concentration of bleaching products has demonstrated to be an important factor in the development of postoperative TS,[13,38] the difference between the concentration of hydrogen peroxide products could explain the differences found in both studies.

In the current study, no significant difference in the TS obtained based on VAS and NRC scales was noted between the experimental (with KNO_3) and control (placebo) groups. However, the absolute risk means observed in those scales reached its maximum score immediately after dental bleaching and up to the first 24 h in both groups, indicating that bleaching sensitivity starts soon after the bleaching procedure.[25] This finding is in agreement with those from previous studies that also reported the existence of major TS within the first 24 h after the whitening process.[38–40] Similarly, TS in both groups reached a mild to moderate scale and decreased significantly in a lapse of 24–48 h after treatment, and after 1-month follow-up, no TS was recorded in neither the control nor the experimental group. These results are in agreement with previous studies, which reported a gradual TS reduction over the course of 24–96 h, even up to 1 week after treatment.[7,25,38,41]

The second hypothesis of this study established that the use of a 5% KNO_3 dentifrice before and during in-office dental bleaching allows same bleaching efficiency compared to regular dentifrices. After 1 month of evaluation using a spectrophotometer, no significant difference in ΔE with both CIELab and CIEDE2000 was observed in the experimental and control groups. In the present study, the CIEDE2000 formula was also used as it reflects the color differences perceived by the human eye better than the CIELab formula (ΔE^*ab).[42] The same trend was observed when using the ΔSGU parameters. Therefore, the second hypothesis was accepted. These findings are in agreement with previous studies, which reported that the use of desensitizing dentifrices does not interfere with the diffusion of peroxide molecules.[20,22,26] Because of their very low-molecular weight (34.40 gram/mol), the molecules of hydrogen peroxide can be transported through the interstitial spaces between the enamel porosities.[20,43] This diffusion process occurs despite the obliterating effect and the decrease in enamel permeability caused by the different substances from the dentifrices.[22,26]

Although the dentifrice containing KNO_3 was not effective in reducing TS after in-office bleaching, it should be mentioned that there are several commercial brands of dentifrices containing KNO_3 currently available. Because these dentifrices may have different formulations and vehicles that could improve their effect, caution should be taken before extrapolating the current findings when other dentifrices with KNO_3 are used. Therefore, further studies with a variety of brands are required to elucidate this aspect.

5 | CONCLUSION

Within the limitations of this current study, it was concluded that:

1. The use of a dentifrice containing 5% KNO_3 before and during in-office dental bleaching does not diminish post-operatory tooth sensitivity.
2. The use of a dentifrice containing 5% KNO_3 before and during in-office dental bleaching allows the same whitening efficiency as a regular dentifrice.

DISCLOSURE

The authors do not have any financial interest in the companies whose materials are included in this article.

DATA AVAILABILITY STATEMENT

Data that support the findings of this study are available from the corresponding author upon reasonable request.

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