

ORIGINAL ARTICLE

ACTIVE ROLE OF POTASSIUM NITRATE TOOTHPASTE FOR TREATING DENTINE HYPERSENSITIVITY AND MAINTAINING THEIR NORMAL PHYSIOLOGY**Afsheen Mansoor, Emaan Mansoor*, Aleeza Sana, Muhammad Mohsin Javaid, Muhammad Salman Asghar, Khadim Hussain****

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Background: Prevalence of dentine hypersensitivity in individuals is increasing globally due to the intake of erosive acidic food beverages and improper brushing protocols in turn adversely affecting the tooth surfaces. Toothpastes containing various potassium salts are very effective in treating the dentine sensitivity when used properly for some time. Herein, we have investigated the association between the dentine sensitivity and 5% potassium nitrate toothpaste usage for a period of one month. **Methods:** For this interventional study, one hundred and forty participants with dentine sensitivity were analysed before and after using 5% potassium nitrate toothpaste. Visual Analog Scale (VAS) scoring tool was employed where sensitivity to Air among the participants was calculated by VAS-Air scoring and sensitivity to cold was tested by VAS-Cold scoring. Paired *t*-test was incorporated for performing the statistical analysis through the IBM SPSS-22. **Results:** There was a strong association between the dentine sensitivity and usage of 5% potassium nitrate toothpaste. After using the 5% potassium nitrate toothpaste for one month, the calculated VAS-Air scoring and VAS-Cold scoring reduced significantly against both the air and cold stimuli which was found to be 2.67 ± 1.12 and 1.86 ± 0.83 ($p=0.001$). **Conclusions:** The 5% potassium nitrate toothpaste was potent enough to reduce the dentine hypersensitivity in the participants against both the thermal and air stimuli.

Keywords: Dentine Hypersensitivity, Erosive food, Thermal stimuli, Toothpaste, Visual Analog Scale

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INTRODUCTION

Recently recorded prevalence of dentin hypersensitivity globally has been ranging between 1.34–98% which is quite alarming.^{1,2} Dentin Hypersensitivity is quite a painful sensation produced and is commonly also referred as Tooth sensitivity or common cold of dentistry.³ This tooth pain experienced by a patient might be of short tenure but acutely excruciating in nature leading to the prolonged discomfort eventually.⁴ This problem often occurs because of eating erosive acidic beverages and using hard, improper brushing techniques that can possibly affect the quality of any individual's life.⁵ These factors further deteriorated the tooth's structure eventually leading to the destruction of entire tooth surfaces.⁶ Sometimes, these routine practices promote the thinning of the outer enamel surfaces of teeth and exposing the dentine prominently via attrition, abrasion, wear, abfraction, erosion, gingival recession and scratches.⁷ Eventually, the widening and opening of dentinal tubules lead to their expansion.⁶ These dentinal tubules get more responsive to many stimuli such as tactile, chemical, mechanical, thermal, osmotic, and physical irrespective of any pathology in them.⁷ Furthermore, these dentinal tubules also allow the absorption of stimulants excessively inside the tooth pulp resulting in its severe irritation, pain and discomfort.⁶ Therefore, it is necessary to block the

dentinal tubule openings for the elimination of these negative hypersensitivity responses in the teeth.

Various toothpastes are exploited to overcome the dentinal hypersensitivity by occluding the widened dentinal tubules on the large scale. These toothpastes include fluorides, chloride hexahydrate, strontium, stannous fluoride, aluminium ferric-oxalates, and potassium ferric-oxalates, and fluorides in their compositions.⁸ Moreover, the most easily available, cost effective and simplest type of toothpaste categories that could be helpful in declining the dentine hypersensitivity incorporated the potassium salts and their compounds. Additionally, the ions present in these potassium salts might be capable of hindering the transmission of pain signals and their impulses through the intra-dental nerves.⁹ Previous studies showed that the longer partakers used toothpastes, the greater reduction in DH.¹⁰ Previously, a toothpaste containing 3% potassium nitrate salt reduced the dentine hypersensitivity to some extent but after the usage for longer duration.¹¹ Still, there is gap in literature regarding the availability of useful potassium salt percentage in the toothpaste that could be potent enough to reduce the dentine hypersensitivity in short time application. The current study focused on treating the chronic dentine hypersensitivity in patients with the help of 5% potassium nitrate containing toothpaste.

METHODOLOGY

This study was conducted for a period of one month, during June–July 2023 in School of Dentistry, Shaheed Zulfiqar Ali Bhutto Medical University Islamabad under Ethical Approval Letter No. SOD/ERB/2023/32.

Participants aged 18 years or older whose Visual Analog Scale (VAS) score for dentine hypersensitivity was in the ranges between 3–8 were included in this study.

Participants whose Visual Analog Scale (VAS) score for dentine hypersensitivity was not in the ranges between 3–8 were excluded from this study. Further, patients with full mouth rehabilitation were also excluded.

One-hundred-forty participants volunteered to take part in this study after their written consents. The tool used to measure the dentine hypersensitivity was Visual Analog Scale (VAS) scoring scale.^{13,14} VAS scoring scale was used in patients before and after using the 5% potassium nitrate toothpaste. Visual Analog Scale (VAS) consisted of a calliper containing 10 mm scale representing the ‘No Pain’ at 0 end and ‘Worst Possible Pain’ at 10 end showing the intensity of pain. Teeth of the participants were tested for sensitivity to air pressure with the help of air dental syringe kept away at distance of one cm from participant’s sensitive teeth involved in the study and air was blasted at least for one second (30 PSI pressure, 23±30 °C temperature) in order to calculate the VAS-Air score. After 5.0 minutes, VAS-Cold for sensitivity to cold stimulus was investigated, by air blasting the cold frozen water for one-second again on the participant’s sensitive teeth involved in the study.

VAS-Air and VAS-Cold score was calculated before providing 5% potassium nitrate toothpaste to these participants. This data was recorded as the Baseline readings. Then, participants were provided with 5% potassium nitrate toothpaste (Sensed toothpaste, Gentle Care Corporation, Pakistan) and soft-bristled toothbrush for brushing their teeth twice a day. They were instructed for maintaining the strict oral hygiene and proper brushing for at least one month with the same toothpaste and toothbrush.

These participants were again recalled for calculating their VAS-Air and VAS-Cold scores after one month to evaluate the effectiveness of toothpaste containing 5% potassium nitrate in reducing the dentine’s hypersensitivity in the participants to both air and Cold stimuli.¹⁵

SPSS-22 was used for the Descriptive analysis of means and standard deviation. Comparison between participant groups before and after was done using Paired *t*-test at 95% confidence interval, and $p \leq 0.05$ was taken as statistically significant.

RESULTS

The results conclude that the level of dentine hypersensitivity significantly reduced in participants using 5% potassium nitrate toothpaste. Sensitivity to air among these participants was calculated by VAS-Air scoring, whereas VAS-Cold scoring tested sensitivity to cold among the same participants. The mean value for the VAS-Air scoring among these participants at baseline before using the 5% potassium nitrate toothpaste was found to be 5.80±1.72 whereas mean value for VAS-Cold scoring was calculated to be 6.89±1.32 which was statistically significant ($p < 0.05$). After using the same 5% potassium nitrate toothpaste for one month, the calculated mean VAS-Air scoring and mean VAS-Cold scoring among the same participants reduced significantly against both the air and cold stimuli. The reduction in the mean VAS-Air score among the study participants after using the toothpaste was found to be 2.67±1.12 and the declination in mean VAS-Cold score was observed to be 1.86±0.83 which was statistically significant ($p < 0.05$) (Figure-1).

Before using toothpaste, participant’s VAS-Air scores were significantly different from those after using toothpaste for a month (Mean±SD 3.129±1.967; $p = 0.001$). As seen by the mean difference of 3.129 (95% CI [2.800, 3.457]), the usage of toothpaste was associated to a significant drop in VAS-Air scores. Similarly, there was a statistically significant difference in the VAS-Cold evaluations of participants before and after using toothpaste (Mean±SD 5.021±1.548; Mean±SD 0.131±4.763; $p = 0.001$). According to the mean difference of 5.021 (95% CI [4.763, 5.280]), using toothpaste was associated with a significant decrease in VAS-Cold ratings (Table-1).

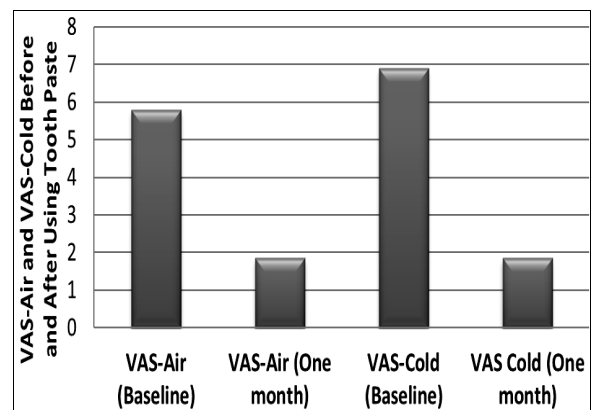


Figure-1: Mean difference of VAS-Scoring against sensitivity to Air (VAS-Air) and Cold (VAS-Cold) before and after using the 5% potassium nitrate toothpaste

Table-1:- Paired *t*-test comparative analysis of VAS-Scoring vs sensitivity to air and cold (VAS-Cold) pre and post using 5% potassium nitrate toothpaste.

VAS-Scoring groups	Comparison of VAS-Air score among participants at baseline and after one month of using 5% potassium nitrate toothpaste	Mean Difference with SD and (SE)	95% CI of the Difference		<i>p</i>
			Lower	Upper	
VAS-Air scoring group	Comparison of VAS-Air score among study participants before and after using 5% potassium nitrate toothpaste	3.12±1.96 (0.16)	2.800	3.457	0.001
VAS-Cold scoring group	Comparison of VAS-Cold score among study participants before and after using 5% potassium nitrate toothpaste	5.02±1.54 (0.13)	4.763	5.280	0.001

DISCUSSION

Dentine hypersensitivity has been a major problem affecting the community on the larger extent.¹¹ Previously, the reported minimum prevalence for dentine hypersensitivity was calculated to be 14.5% whereas the maximum value was found to be 57%.^{15,16} Multiple factors acting simultaneously enhance dentine hypersensitivity. This severe problem of dentine hypersensitivity could be resolved easily with the help of potassium salt/compound-oriented toothpaste that could be capable of treating this common issue prevailing in our daily routine.

The current study investigated the effect of 5% potassium nitrate toothpaste on dentine's hypersensitivity of patients. The results of our study displayed statistically significant deduction in the dentine hypersensitivity of participants against both air and cold stimuli after the usage of this toothpaste for the duration of one month. The findings in this study were similar to a previous research¹⁷ but with a potassium citrate toothpaste and not potassium nitrate salt. The reasons for dentine's hypersensitivity reduction in our study could possibly be the increased amounts of potassium ion absorption in the dentinal tubules that might have prohibited them from sending the sensitivity occupying signals to the nerves¹⁸. Secondly, this viable entrance of potassium nitrate ions in the widened dentinal tubules might have brought them to their natural biological morphology by narrowing them, thus, reducing the dentine's hypersensitivity to a statistically significant level.

Preferable tool for measuring the clinical dentine's hypersensitivity is named as Visual Analog Scoring (VAS) system because of its ability to reproduce more valid and reliable results regarding tooth's sensitivity measurements.^{19,20} Others have confirmed that this system is cost-effective, more sensitive and quite easy for recording the perception of pain and sensitivity in individuals appropriately.^{20,21} Hence, accurate results attained in the current study were due to harnessing the authentic operating system of Visual Analog Scoring (VAS) system.

The most reliable methods employed by the dental practitioners to evaluate the dentine's hypersensitivity are through thermal¹⁹ and air in the Value Analog Scoring system²². The major cause for obtaining the reliable results by using the Thermal (hot and cold) and air blasting was because of the short-time

application of these stimuli for only one second on the sensitive tooth surfaces.^{19,23} The current study incorporated both thermal and air blast techniques to calculate the effects of 5% potassium nitrate toothpaste on the dentine's hypersensitivity. The induction of two different tools at the same time in our research might have increased the validity and reliability of results respectively. The statistically significant reduction in both VAS-Air scoring and VAS-Cold scoring was noticed in participants of this study with toothpaste containing 5% potassium nitrate. These results were similar to another study where potassium citrate was used instead of potassium nitrate.¹⁷

Different toothpastes that include potassium-chloride and potassium-citrate in their compositions are clinically acceptable for treating the hypersensitivity of dentine.^{24,25} On the other hand, potassium-nitrate containing toothpastes are approved by American Dental Association Council on Dental Therapeutics and Drugs. The ions released by potassium-nitrate are well-known for reducing the excitation of nerves especially intra-dental nerves, thereby resulting in pain and sensitivity cessation quite actively.²⁶ Antibiotics are also prescribed in dental pain and some factors should be considered when prescribing them.^{27,28} Potassium salts, specifically potassium-citrate and potassium-nitrate, possess the upgraded qualities of reducing the hypersensitivity of dentine.²⁸ Dentinal hypersensitivity is a common symptom of many dental diseases¹⁸, hence the dental experts should help provide the patients with necessary education on oral hygiene.²⁹

Further studies are required to investigate the positive role of different types of toothpaste salts in the reduction of tooth's hypersensitivity other than only using the potassium salts and compounds.

CONCLUSIONS

Utilization of 5% potassium nitrate toothpaste on regular basis for complete one month is potent enough to reduce the hypersensitivity of dentine which can be treated easily by just adopting normal brushing protocols with toothpastes containing potassium nitrate salt.

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