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Sesame extraction gel as an agent for prevention of dental caries: An in-vitro study

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Original Article

Abstract

BACKGROUND AND AIM: Sesame has a high content of calcium. Regarding to the lack of adequate data about its remineralizing potential, we conducted this study to evaluate the surface hardness of enamel exposed to sesame extraction gel in comparison to artificial saliva and fluoride.

METHODS: After mounting and polishing twenty-four caries-free human premolars, the baseline microhardness was recorded. Subsequently, decalcification was accomplished by immersing into cola, after which the surface hardness was recorded again. Ultimately, the samples were divided into three groups, which were treated by either the sesame gel (SG), artificial saliva (AS) or the fluoride gel (FG). The final microhardness was assessed again. The repeated measure analysis of variance (ANOVA) was employed for comparison of baseline (B), decalcified (R) and remineralized (R) hardness while the one-way ANOVA followed by least significant difference test was used for comparison of different remineralizing agents.

RESULTS: There was significant difference among the teeth at baseline, after decalcification and after treatment by experimental solutions ($P < 0.001$ and $P = 0.002$ for pair wise comparison of B/D and D/R, respectively). Moreover, after remineralizing treatment, there was no significance difference between the solutions ($P = 0.350$, $P = 0.150$ and $P = 0.610$ for pair-wise comparisons of SG-FG, SG-AS, FG-AS, respectively). However, the mean microhardness value was increasing in that order.

CONCLUSION: Although treating the decalcified enamel by sesame extraction enhanced its microhardness, there was no significant difference between sesame, fluoride and artificial saliva when they were applied for just 15 min.

KEYWORDS: Sesame; Dental Enamel; Hardness

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Dental caries, which is still a major public health problem and is the most frequent infectious disease in the human society, could lead to high morbidity rate.[1] Dental treatments are often costly and painful which shift both practitioners and patients toward prevention instead of restoration of tooth caries.[2] Carious lesion, which represents as cavitation, is the result of mineral loss from the tooth structure due to production of acid by cariogenic bacteria.[3] Therefore, any remineralizing agent that exposes the tooth surface to mineral rich saliva,[4] could compensate and even prevent this process.[3] Although fluoride has a rich successful history and serves as an inexpensive topical agent in dental clinics,[2] many investigations were accomplished seeking for new remineralizing materials to eliminate the drawbacks of fluoride including

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its toxicity.[5-8] Accordingly, some innovative calcium phosphate materials such as bioactive glass, milk-derived protein and amorphous calcium phosphate were introduced recently.[9,10] However, in view of their high cost and essential modern technology vehicles, their application is still limited in dental clinics despite their enormously proved remineralizing efficacy.[2,6,8]

In recent years, the increased interest in alternative and complementary medicine has encouraged the dental researchers to explore the influence of various natural products against tooth caries,[11-13] particularly due to their lack of side effects on body tissues beside their economic features.[14] The oil pulling therapy has been extensively documented in traditional remedy in order to strengthen the tooth, jaw and gums as well as a useful management for prevention of tooth decay.[15] While several herbal oils were prescribed for this therapeutic purpose in folk medicine, sesame oil was one of the most famous ones.[15] Nonetheless, contemporary investigations revealed that sesame is one of the most reliable herbal sources of calcium.[16-19] Consequently, some studies provided scientific evidence demonstrating that oil pulling therapy by sesame oil could be applied as a preventive strategy against dental caries.[16,20,21] However, to the best of our knowledge, there is no available data about the remineralizing capacity of sesame oil on tooth structure. Therefore, this study was conducted to evaluate the surface hardness of enamel exposed to sesame extraction gel in comparison to artificial saliva and fluoride gel.

Methods

This is an experimental in vitro study in which the blinded operators accomplished all process of preparing the samples and testing. All the teeth as well as solutions were coded and at the end of the statistical analysis, they were de-coded by the same person.

Preparation of sesame extract gel: The sesame gel was prepared by an expert professor at the Pharmacology School of the Shahid Beheshti University of Medical Sciences, Tehran, Iran.

In order to prepare the extract, 200 gr of black sesame seed (which was purchased locally) were immersed in boiled water for 4 hours. Subsequently, they were filtrated, the solvent was evaporated and the residues were weighed that was roughly 20 g. Finally, it was admixed with 80 g of Carbomer 934 to produce an applicable 20% gel.

Preparation of the teeth: Twenty-four healthy human premolars extracted for orthodontic reasons were used in this study. The tap water was used as storage liquid and was replaced twice a week. In order to exclude unacceptable samples, the teeth were firstly cleaned with a low speed hand piece using brushes and slurry of pumice. At the next step, stereomicroscope was employed (40x magnification, Carton Optimal Industries Ltd, Thailand). The teeth that had crack were excluded and caries-free teeth were included. Thereafter, epoxy resin was used to mount the teeth before flattening and wet polishing of enamel by 5000-grit silicone paper.

Microhardness test: The baseline microhardness was assessed using a Vickers indenter (Shimadzu M g5037, Japan) at 50 g load. We made three indentations on each specimen.

It is noteworthy that all the microhardness tests (at the baseline, after de- and remineralization) were accomplished by a single operator at Amir-Kabir University of Industrial Sciences, Tehran.

Demineralization process: All of the specimens were exposed to an acidic cola based drink (Khoshgovar, Tehran, Iran) for 8 min that was replaced every 2 min in order to stabilize the PH (4.7). Thereafter, the microhardness of every sample was recorded again.

Remineralization process: The samples were randomly divided into three groups those were exposed to either artificial saliva (AS) (Hypozalix spray, Biocodex, France), fluoride gel (FG) (acidulated phosphate fluoride, Pascadental, USA) and the experimental sesame gel (SG) for 15 min.

Ultimately, the final microhardness value was measured.

After exploring the normal distribution of the data (Kolmogorov-Smirnov), the average hardness of the teeth at the baseline, and after demineralization and remineralization were compared using repeated measure analysis of variance (ANOVA) test. Moreover, for comparison of the experimental solutions after remineralizing treatment, the one-way ANOVA test was incorporated followed by least significant difference and post hoc tests. The level of significance was determined as P = 0.05.

Results

Our analysis revealed that the microhardness value was diminished after soaking in the demineralizing solution while it was increased again roughly similar after incorporation of all remineralizing agents.

Figure 1 shows the mean value of microhardness related to all of the samples at the baseline, after immersing in acidic cola drink (decalcified) and after remineralization by experimental solutions (incorporating either AS, FG or SG). The baseline microhardness was significantly diminished after 8 min exposure to cola drink (P < 0.001) while it was significantly increased after 15 min treatment by remineralizing solutions (P = 0.002). Therefore, it was proved that the acidic cola drink had an adverse effect on the human enamel. However, all the three remineralizing solutions compensated this damage.

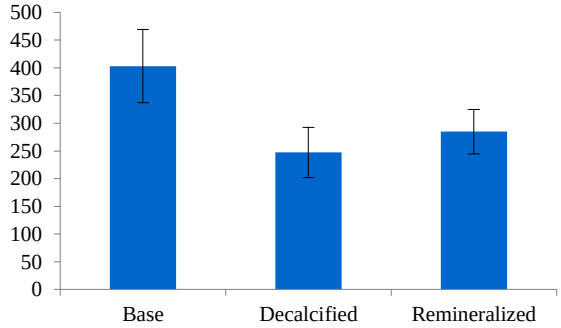

Figure 1. The mean value of microhardness ± Standard deviation (SD) related to all tested teeth

On the other hand, figure 2 represents the mean microhardness value of three remineralizing sub-groups. Obviously, the highest microhardness was recorded in SG followed by FG whereas the least was regarded to AS. However, statistical analysis revealed no significant difference among these subgroups (P = 0.35, 0.15 and 0.61 for pair-wise comparisons of SG-FG, SG-AS, FG-AS, respectively). Therefore, it was demonstrated that 15 min treatment by either AS, FG or SG would increase the microhardness of demineralized human enamel. Although the results were roughly similar to each other, the sesame was the most effective one.

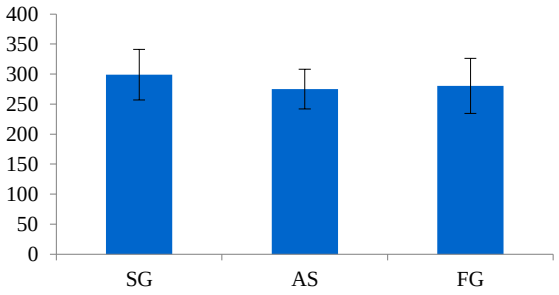

Figure 2. The mean value of microhardness ± Standard deviation (SD) related to remineralizing subgroups

Discussion

The results of the current study revealed that sesame extraction could increase the surface hardness of tooth enamel after exposure to cola based drinks. This finding may prove the remineralization ability of sesame on tooth enamel.

Since most tooth remineralizing materials consist of calcium and phosphate,[5-8] and sesame is rich in these minerals, it could be assumed that sesame could be used as tooth mineralizing agent. This theory is in consistent with Abebe et al.[16] and Kamchan et al.[18] who measured the mineral fractions of different foods and they reported the highest amount of calcium in sesame. In fact, in many previous publications, sesame was reported as one of the most drastic sources of calcium in nutrition.[16-18] However, despite this

calcium enrichment, the bioavailability of sesame's calcium is quite limited.[16,18] This fact is related to other ingredients of sesame such as phytate, oxalate and dietary fiber content that inhibit the absorption of calcium in human gastrointestinal system.[16,18] It has been documented that these three compounds, especially the oxalate, has prompt negative effect on the calcium dialysability.[18]

However, our investigation hypothesized that the sesame's calcium could precipitate on the tooth surface leading to enhancement of surface hardness and it is the first time that the surface hardness of human tooth enamel is reported after incorporation of sesame extraction.

Nonetheless, the benefits of sesame oil have been frequently proved in oil pulling therapy for prevention of plaque formation. Actually, some studies were carried on the anti-cariogenic potential of sesame oil[15,20,21] and they proposed two mechanisms. Firstly, sesame oil was introduced as an effective agent against biofilm formation on tooth surface that could be attributed to its oily structure, which is the base of oil pulling theory for prevention of dental plaque.[15,20,21] Moreover, sesame has anti-bacterial potential against main cariogenic bacteria including Streptococcus mutans. Thaweboon et al. claimed that sesame could significantly inhibit the growth of S. mutans.[21] Therefore, sesame could be quite favorable in dentistry especially that this natural gift does not have any side effect on human body. Moreover, it could be considered as an economic material.

It should be noted that we did not used fresh sesame seed in our experiment because in previous documentations it was reported that different ingredients of sesame are resistance to oxidation and their stability over time is trustable.[17]

The surface hardness test was incorporated in many articles as a quite reliable test exploring the mineral content of tooth surface. In fact, as the calcium substance of the enamel increase, its surface hardness would increase dramatically. Among various hardness tests including Vickers, Barcol's, Knoop, etc., the Vickers is frequently used in enamel investigations due to the brittle structure of enamel.

According to our statistical analysis comparing the Vickers surface harness, after remineralizing procedure, there was no significant difference among either of the groups. It means that in statistical point of view, there was no significant difference between artificial saliva, sesame gel and fluoride gel. However, the exact mean value was highest in sesame group followed by fluoride and the least one was in artificial saliva. Thus, this lack of significant difference could be possibly explained by the short exposure time, which was 15 min in all subgroups. Therefore, prolonged treatment intervals are strongly suggested in future studies.

Sesame extraction had the potential of increasing the surface hardness of human enamel that was decalcified by an acidic beverage. Hence it could be assumed that the incorporated gel had possible remineralizing effect.

Conclusion

It was revealed that exposing the human enamel to an acidic cola based drink would diminish its surface hardness while treating with the sesame or fluoride gel would enhance this property. However, by 15 min incorporation of experimental gels, no statistically significant difference was obtained among the groups compared to artificial saliva.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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