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Effect of Kedo sdf gel in early enamel caries remineralisation

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Abstract:
Introduction;
The effectiveness of silver and silver compounds as antibacterial agents has It has been widely established that SDF effectively stops cavities from growing once they have already started. Dentists refer to this occurrence as caries resonance.SDF is commonly suggested as a more comfortable alternative to drilling cavities since it helps eradicate the bacteria that degrade tooth surfaces and stops them from spreading to nearby teeth.
Aim: The aim of this study is to access the remineralisation capacity of kedo sdf gel in teeth affected by early enamel caries
Materials and methods: A total of 3 groups after inducing artificial early enamel caries with 4 samples each , group 1 control sample , group 2 sample soaked in artificial remineralisation medium mimicking saliva and group 3 with samples soaked in kedo sdf gel. SEM and EDX analysis was performed.
Results: SEM analysis concluded that kedo sdf had the best remineralisation results followed by the samples in artificial remineralisation medium mimicking saliva followed by the control group. EDX analysis concluded that the amount of calcium has significantly increased in the sample soaked in kedo sdf gel
Conclusion: In conclusion, kedo SDF is a versatile, cost-effective, and efficient agent. In comparison to an artificial remineralization solution, Kedo SDF demonstrated higher remineralization.
Keywords: Remineralisation,kedo sdf, enamel caries, calcium

Introduction;

Dental caries is an infectious, widespread chronic illness. It is caused by cariogenic bacteria that adhere to teeth and produce acid when they consume sweets, demineralizing tooth structure over time. (1)The most frequent cause of dental caries is the interaction of dental plaque, a high-sugar diet, and the susceptibility of the host. Additionally, it has been established that the liquid from tooth plaque is a major contributor to dental caries.(2)Early intervention or prevention of the development of dental caries is crucial because the harm it can do over time to a person's oral health and quality of life is cumulative.(3)There are numerous strategies and preventative measures to reduce the likelihood of dental problems.

Controlling biofilm is the most widely used and effective strategy for treating caries.in addition to a healthy diet and routine fluoride applications.

Mineral demineralization and destruction of the organic matrix of the type 1 collagen fiber network are two characteristics of caries progression. This is in contrast to what occurs in enamel, where the highly mineralized tissues are attacked by the bacterial acids, causing disintegration.(4)Over the years, numerous topical and systemic treatments have been created and investigated for the prevention of tooth decay. The antibacterial benefits of silver in water purification and milk storage have long been known to the general public.

In general medicine, the antibacterial efficiency of silver and silver compounds has been used in a range of situations, including cardiac devices, soft tissue wound care, and reconstructive osseous procedures.(5)The three putative silver-based antibacterial mechanisms listed below are: To stop cellular respiration: Accidental binding of silver ions to bacterial cell surfaces disrupts membrane transport systems, allowing penetration of microorganisms by silver ions. 2. Cell division in reproduction By interacting with the base pairs of deoxyribonucleic acid, silver ions prevent replication. 3. Cellular physiology is disturbed by silver ions.(6)

The effectiveness of silver and silver compounds as antibacterial agents has It has been widely established that SDF effectively stops cavities from growing once they have already started.(7) Dentists refer to this occurrence as caries resonance.SDF is commonly suggested as a more comfortable alternative to drilling cavities since it helps eradicate the bacteria that degrade tooth surfaces and stops them from spreading to nearby teeth. This can be helpful for children, individuals who have dental fear, or those who might not be able to fully participate in dental procedures, such as those who have particular healthcare needs.SDF might be helpful if you have a high level of sensitivity to the substances and instruments used to treat cavities.(8)SDF is a quick and painless process as opposed to conventional practices, such as cavity filling. It might therefore be a great choice for kids, especially for very young children who experience situational anxiety. It might be a good option for some people with particular needs, like those who have intellectual and developmental disabilities. The purpose of this study is to evaluate kedo sdf gel's capacity to remineralize an early enamel caries lesion in a primary tooth.(9)

Materials and methods :
Specimen preparation:
Healthy primary anteriors without caries, discoloration, or structural defects were used as specimens (n = 12),the total sample size computed was 12 for 3 groups. The anterior teeth were stored in a freezer before being used. The dried specimens were then immersed in demineralising solution 3days. Using a low-speed handpiece , all specimens were sectioned (10 mm × 5 mm × 5 mm) from the labial surface of the anteriors.
Artificial caries generation:
The three groups were immersed in 10 ml of demineralisation solution for 3 days at 37 degree Celsius in artificial saliva , then the sample was kept in remineralisation solution for 9 days in 10 ml solution group wise. Group 1 is control , group 2 kedo sdf sample and group 3 is artificial salivary remineralisation.
Kedo sdf gel application:
Group 2 , 4 samples each applied with kedo sdf gel were dried and kept in artificial saliva for a time period of 10 days followed by which the samples were analysed for the remineralisation capacity.
Assessment of remineralisation;
Scanning Electron Microscopy:
Scanning electron microscopy (SEM) for surface analysis was performed with a field-emission scanning electron microscope operating at 15 kV using randomly selected 2 specimens from each group. After drying the specimens with a freeze dryer, an ion coater was used to coat platinum on them to a thickness of 100 nm, following which the SEM observations were carried out. The images were obtained at various magnifications.
EDX:
To provide a specimen map, energy-dispersive X-ray analysis (EDX) is used in conjunction with scanning electron microscopy (SEM) to analyze the types and quantities of elements at the nanomaterial surface or in the vicinity of the surface.When placed close to or at the surface of a sample, the EDX allows for the measurement of the heavy metal ion content and quantity in the nanoparticles.
Results:

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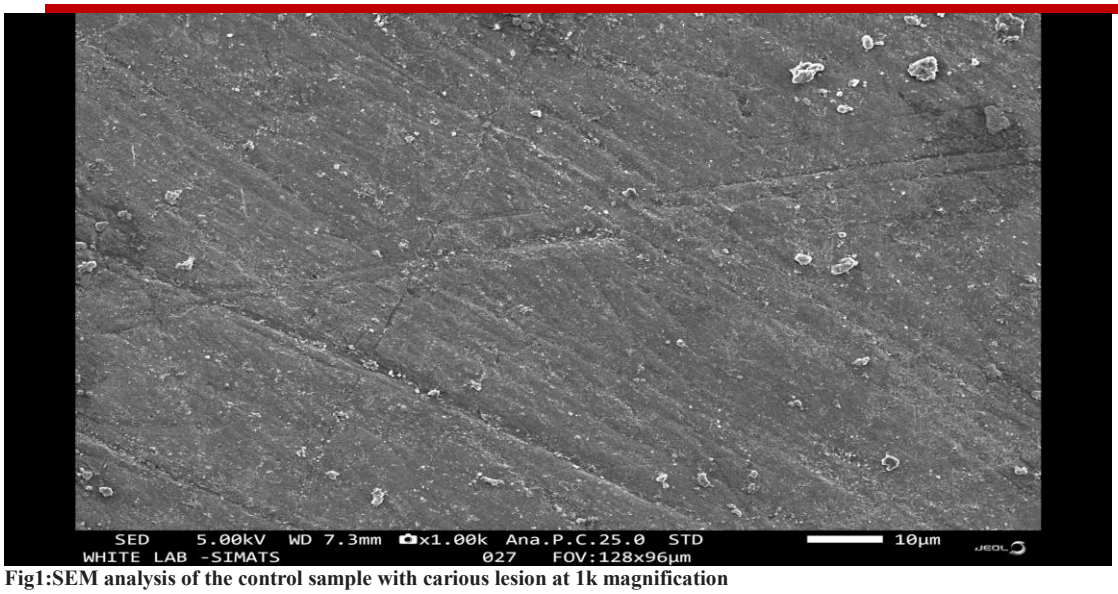

Fig1:SEM analysis of the control sample with carious lesion at 1k magnification

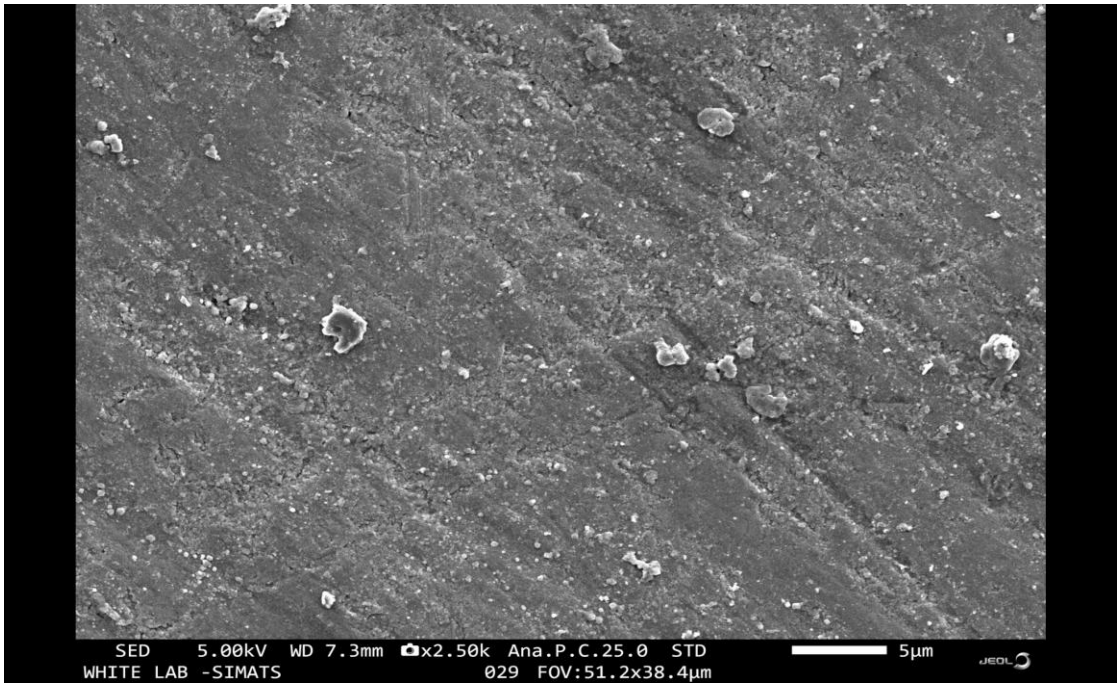

Fig 2:SEM analysis of the control sample with carious lesion at 2.5 k magnification

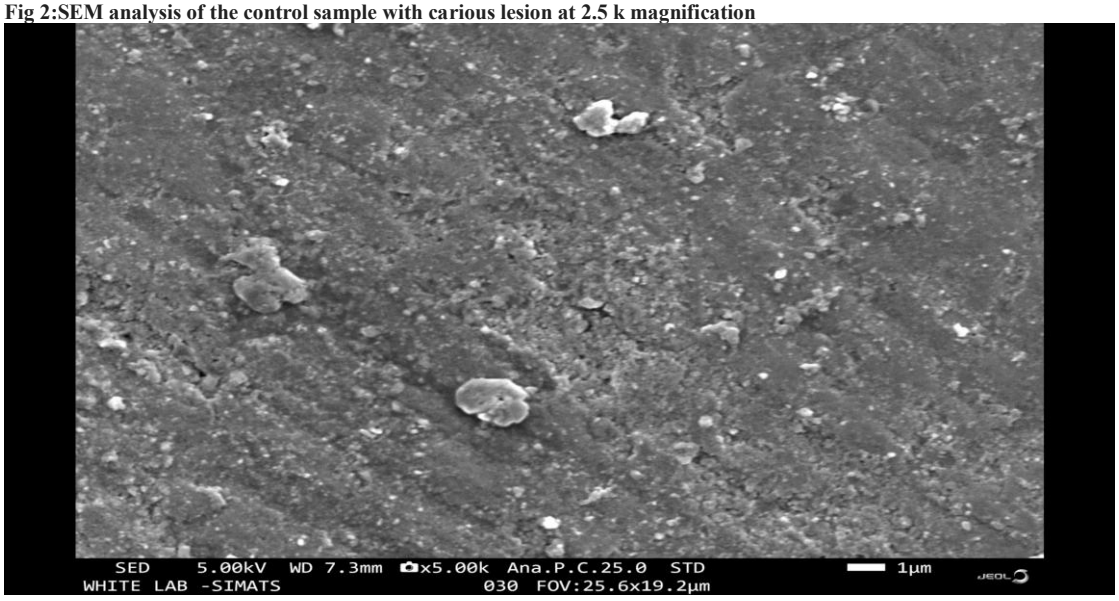

Fig 3:SEM analysis of the control sample with carious lesion at 5k magnification

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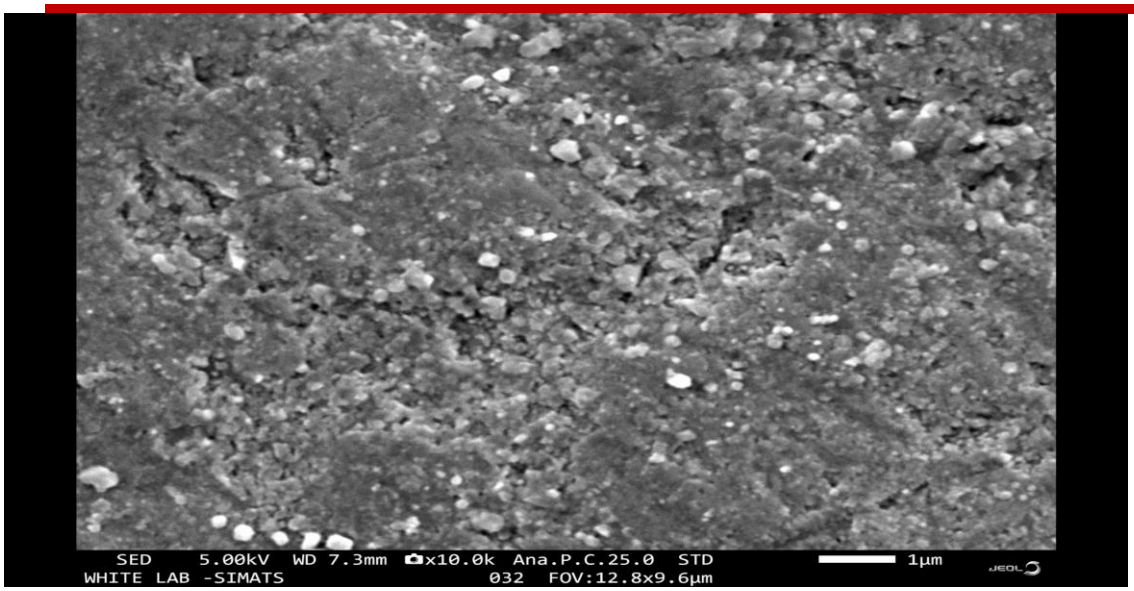

Fig 4:SEM analysis of the control sample with carious lesion at 10k magnification

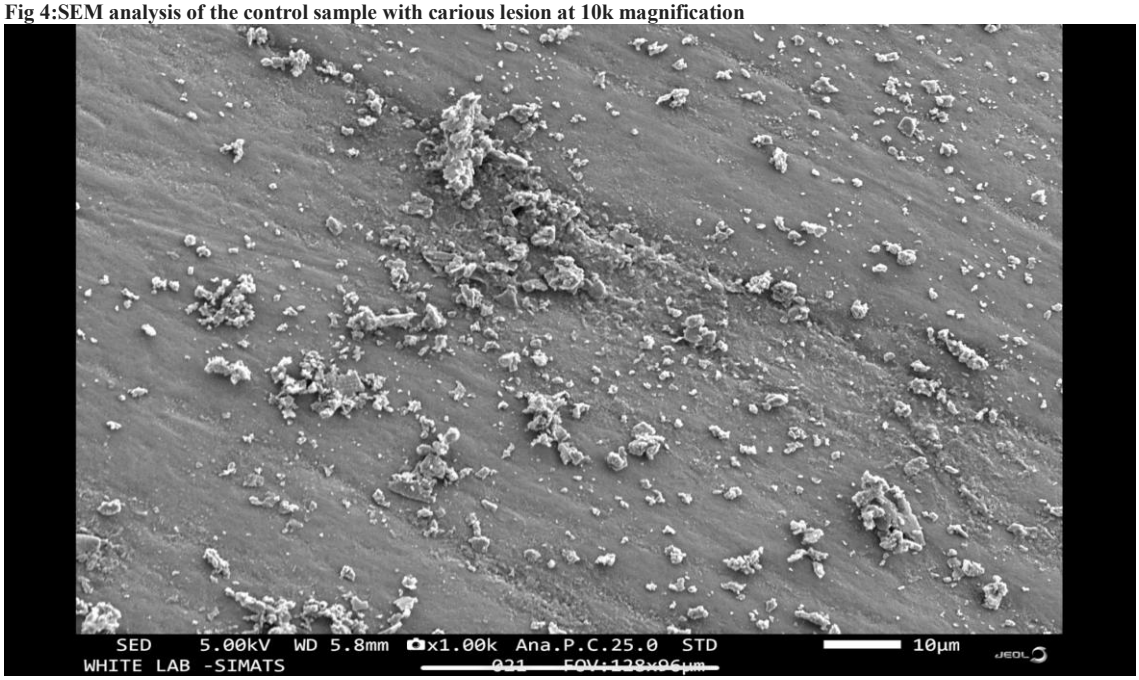

Fig 5:SEM analysis of the sample in the artificial salivary medium at 1k magnification

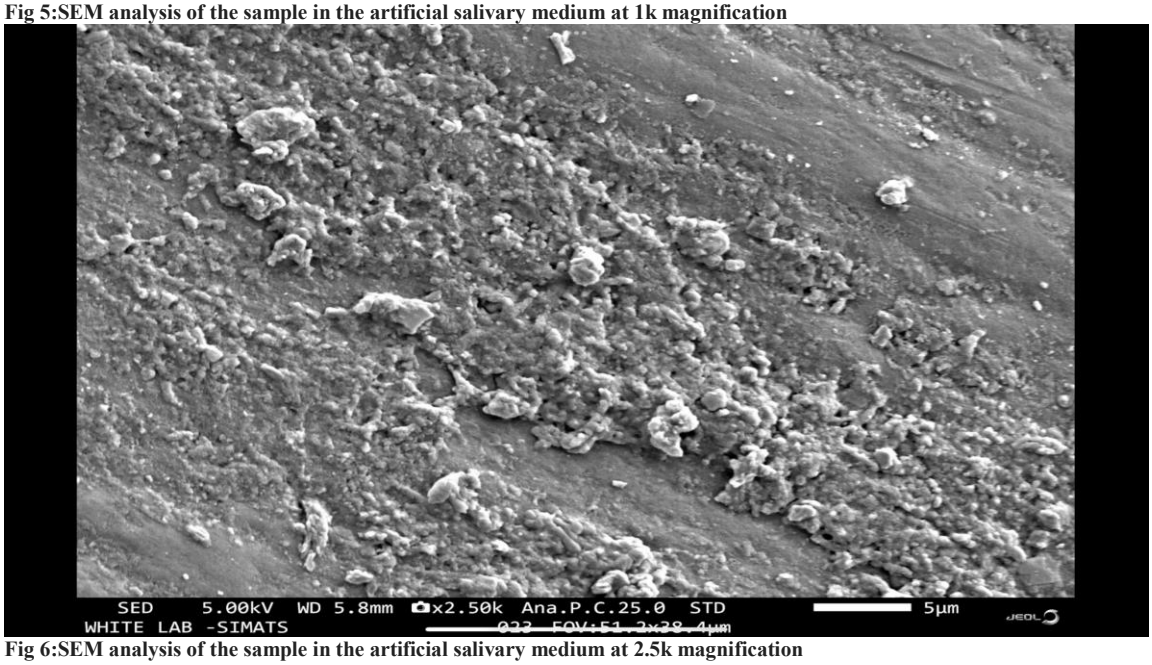

Fig 6:SEM analysis of the sample in the artificial salivary medium at 2.5k magnification

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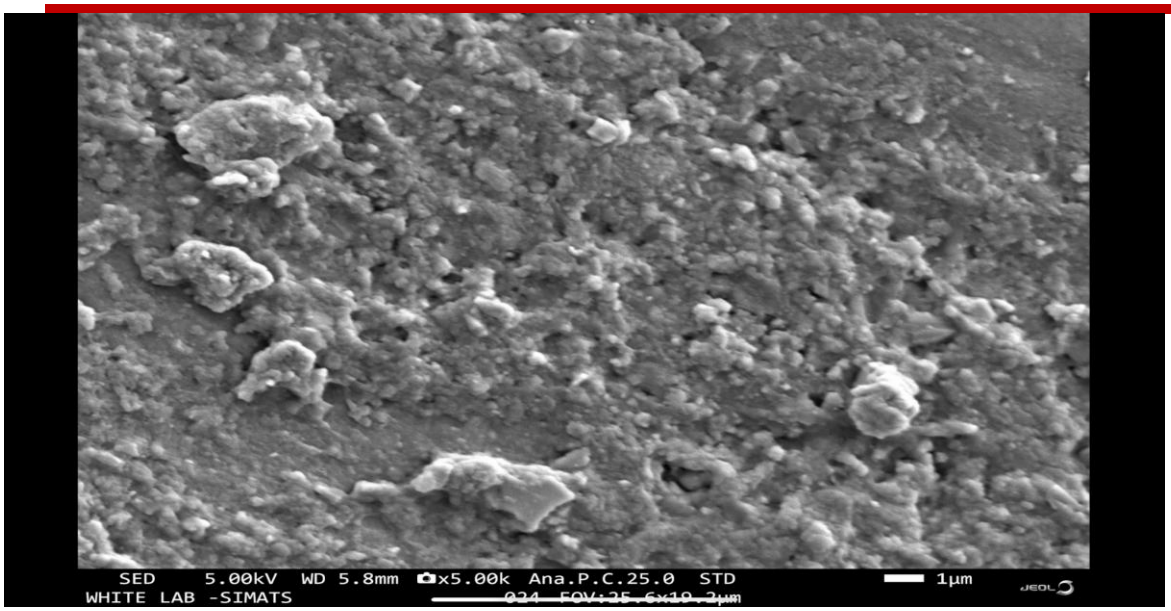

Fig 7:SEM analysis of the sample in the artificial salivary medium at 5k magnification

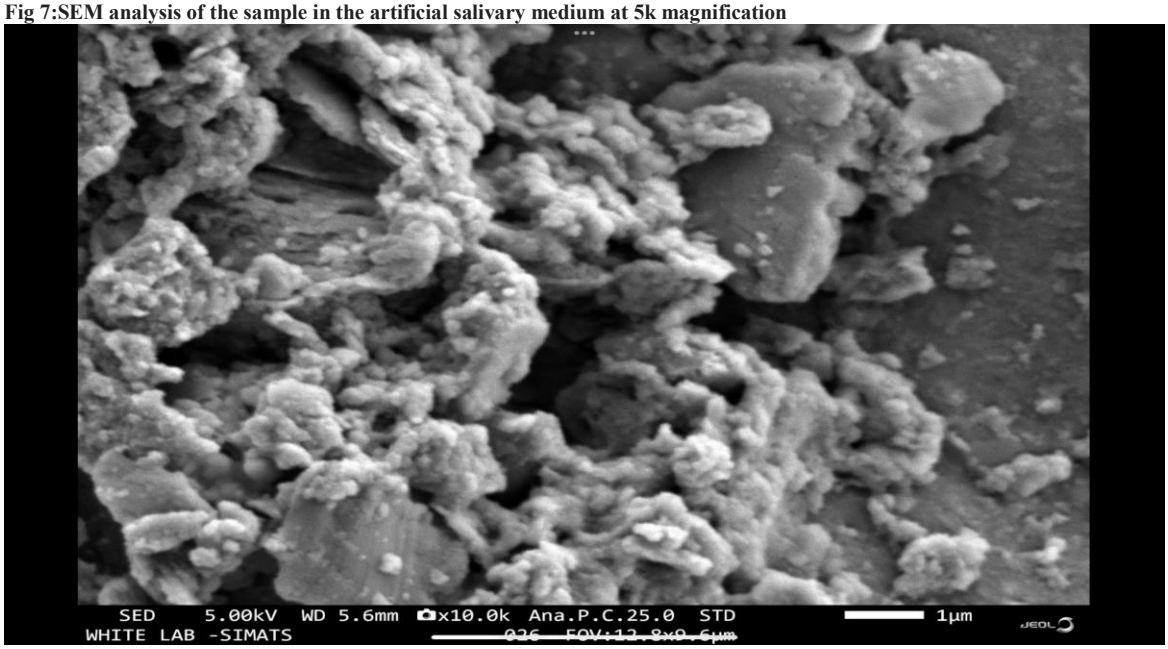

Fig 8: SEM analysis of the sample in the artificial salivary medium at 10k magnification

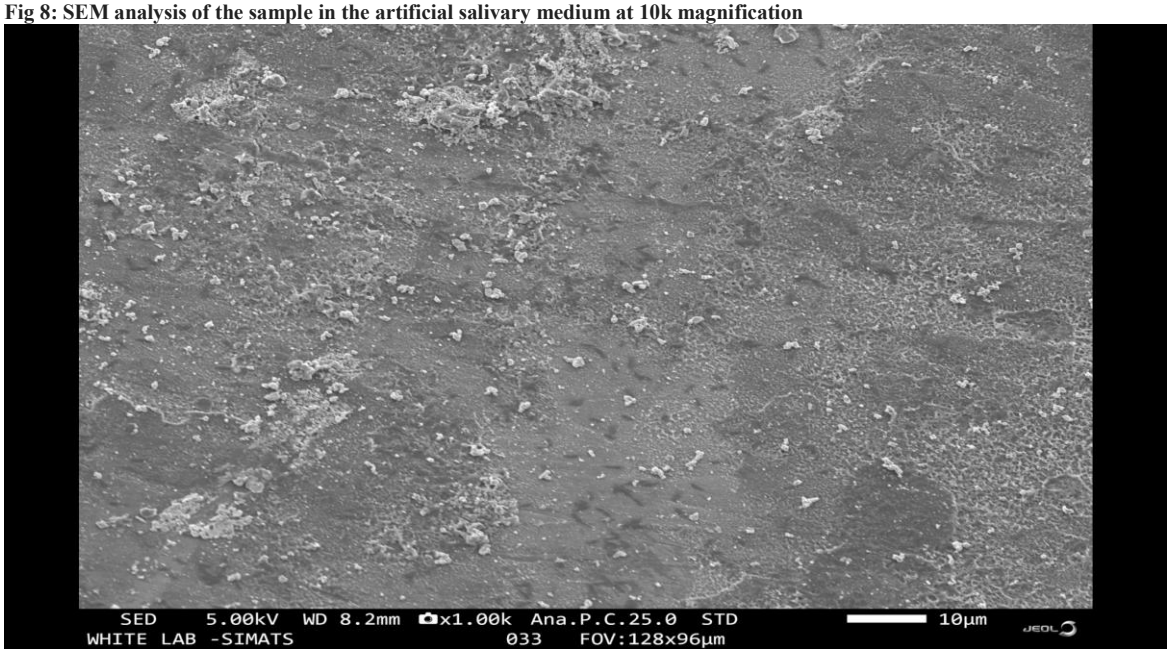

Fig 9:SEM analysis of the sample after application of kedo sdf gel at 1k magnification

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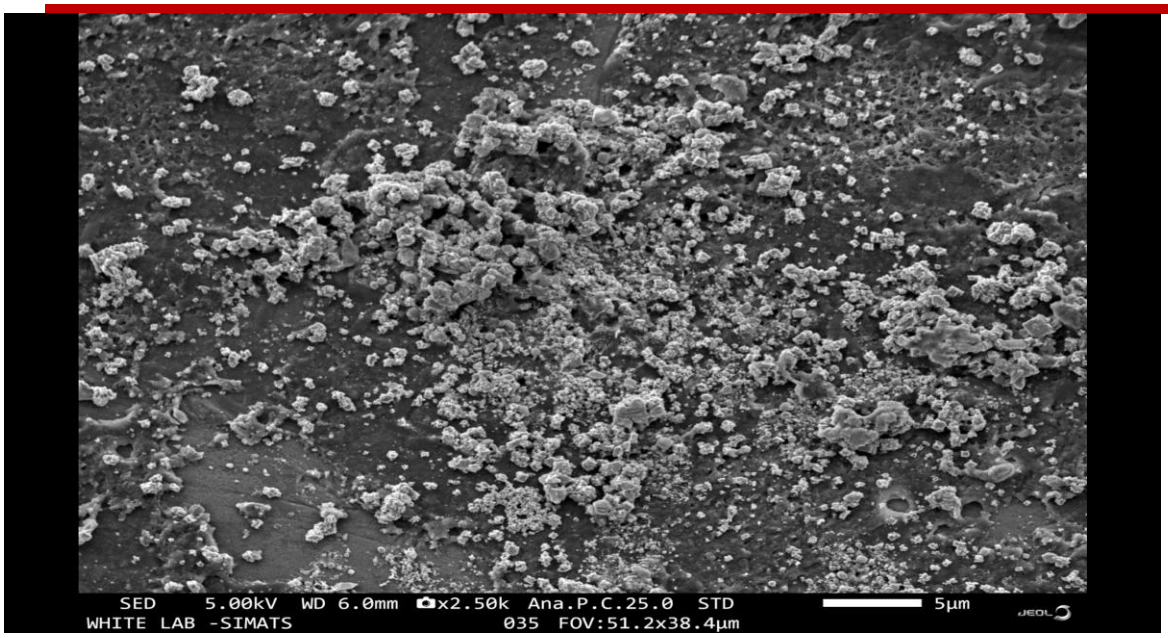

Fig 10:SEM analysis of the sample after application of kedo sdf gel at 2.5k magnification

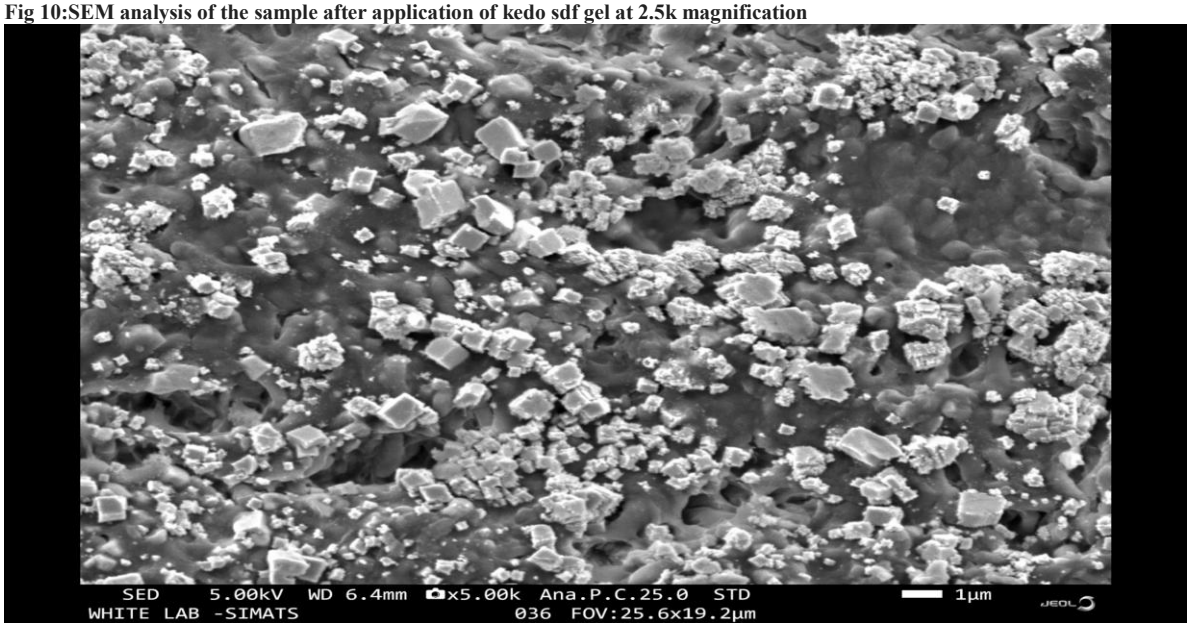

Fig 11:SEM analysis of the sample after application of kedo sdf gel at 5k magnification

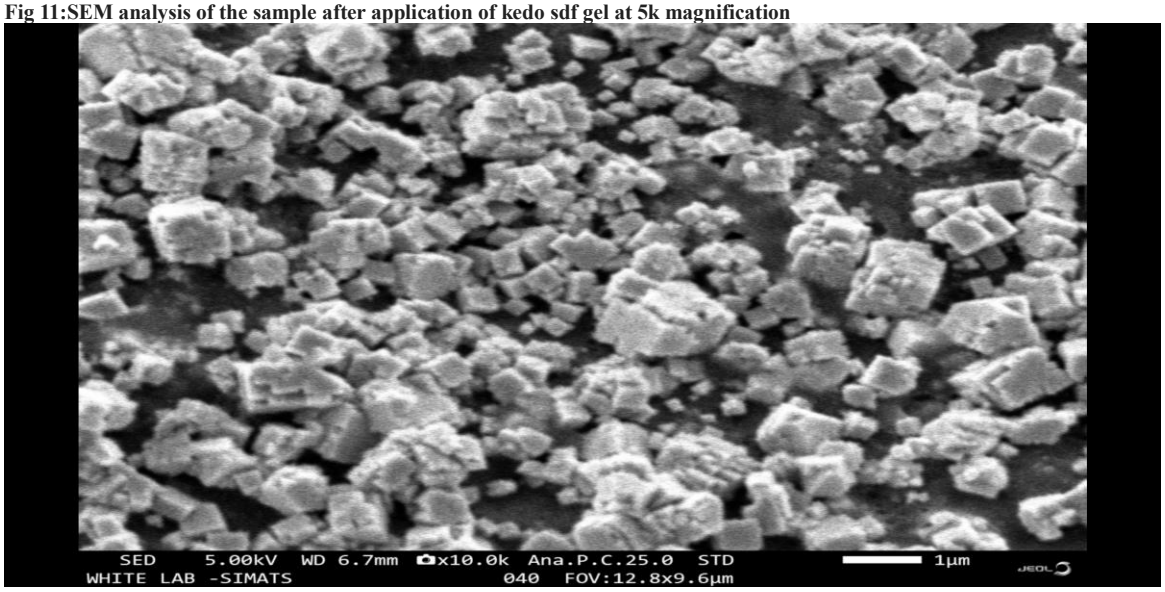

Fig 12:SEM analysis of the sample after application of kedo sdf gel at 10 k magnification

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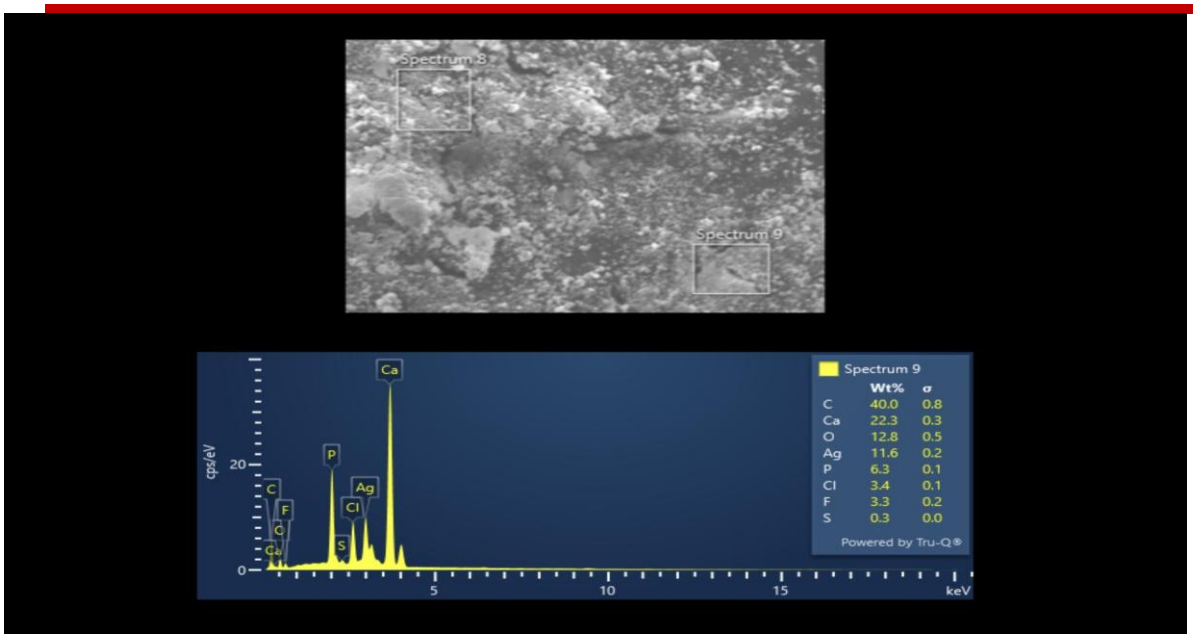

Fig13: EDX of control sample with carious lesion

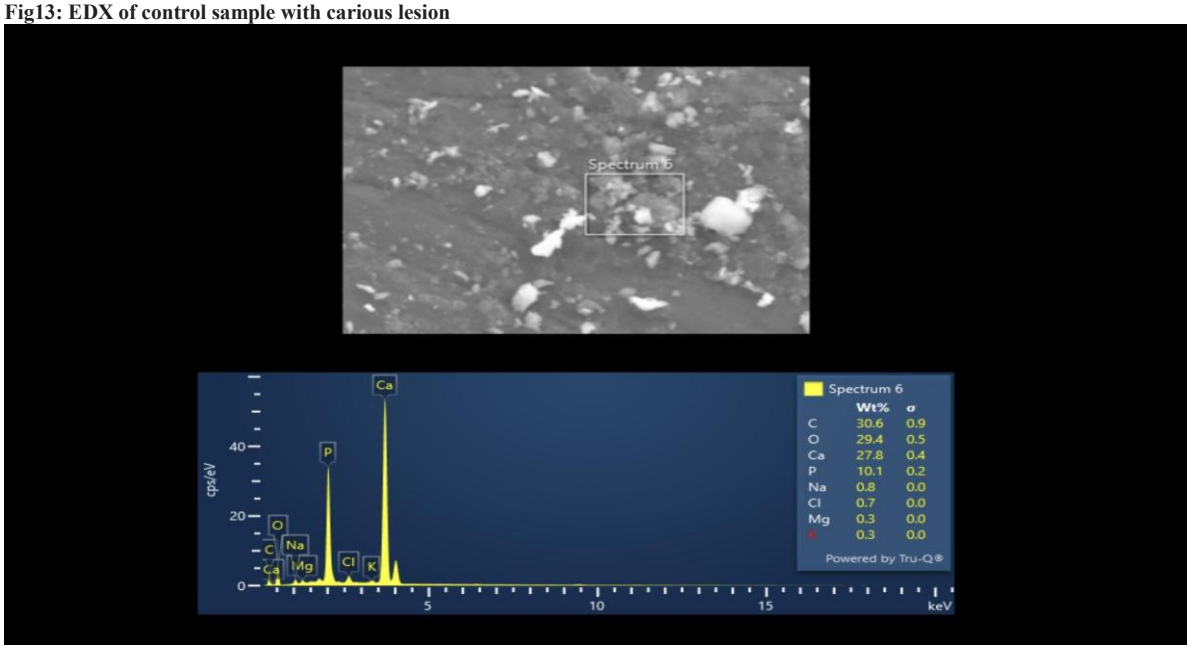

Fig14: EDX of sample in artificial saliva sample

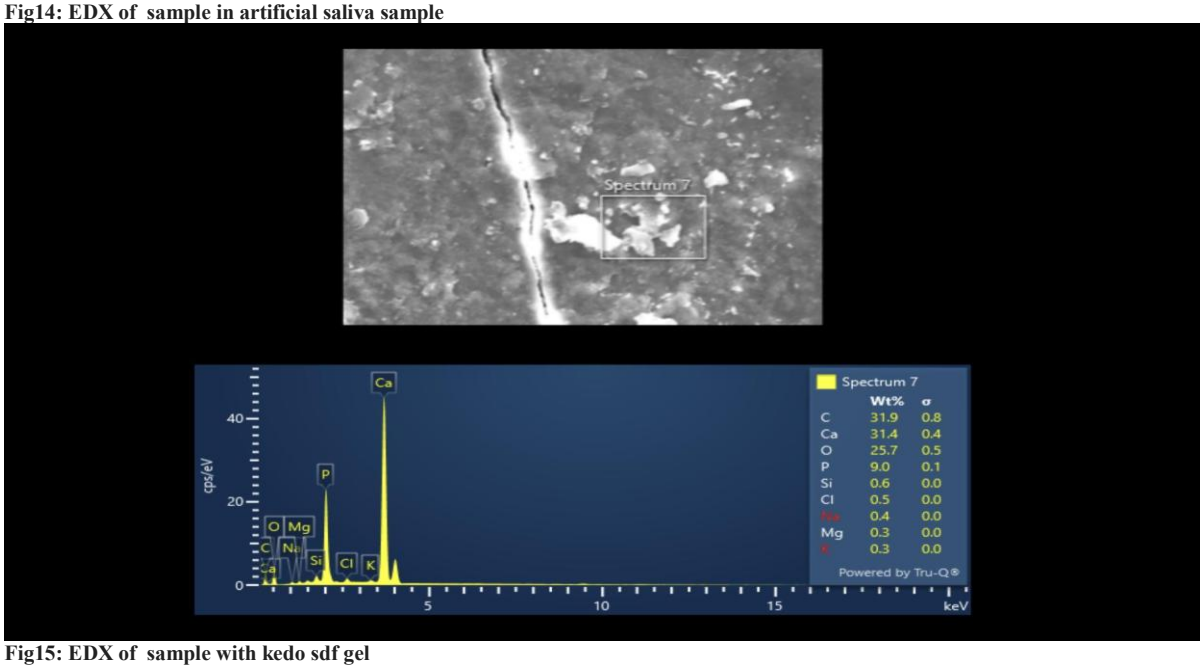

Fig15: EDX of sample with kedo sdf gel

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Discussion:In the current study, the effects of using kedo SDF to treat artificial enamel caries lesions were assessed. In comparison to the application of a remineralization agent that mimics saliva in enamel caries, the application of kedo SDF resulted in a significant difference in enamel remineralization as seen while comparing Figures 5,6,7,8,9,10,11,12. Comparing Figs 1,5 and 9 we can observe that there is significant remineralisation in the artificial salivary medium and in that of kedo sdf applied sample while the kedo sdf sample shows the best remineralisation capacity. Comparing figs 6 and 10 it can be observed that there is irregular remineralisation in the sample present in artificial salivary medium while there is homogenous remineralisation with uniform size of minerals in the sample with kedo sdf gel

Figs 12 and 8 show that remineralisation due to kedo sdf has a cuboidal pattern of particles while that of the sample in artificial salivary medium has irregular pattern.According to research on pharmacokinetics, kedo SDF is a topical medication that is generally safe and biocompatible and has a high level of effectiveness in preventing and arresting tooth decay.(10) In Braga's study, dental caries in the primary dentition were quickly and effectively stopped by kedo SDF.(10,11) Additionally, it has been discovered that kedo SDF can be used as a disinfectant during root canal therapy, to treat tooth hypersensitivity, and to cause dentine desensitization.(12) In contrast to other fluoride agents, it is also cost-effective, simple to use, and has a broad application range, from mild caries that has not yet progressed to dentin to enamel-limited early dental caries.(12,13)

The aesthetic issue brought on by discolored tooth surfaces is SDF's biggest drawback. This is so that silver iodide, which has a white color, can be produced when kedo sdf solution reacts with the extra free ions.(14) To address the problem of SDF-induced discoloration, the use of a saturated KI solution right away after SDF application was advised.(15)Numerous in vitro studies have demonstrated how well KI reduces discoloration. Improvements in aesthetics have also been seen in clinical studies on primary dentition. However, the impact of kedo SDF on tooth color is still debatable; according to a clinical trial, adult root caries still cause tooth discoloration.(16)

Discoloration may be influenced by how far the caries has spread, or whether it has reached the dentin or only the enamel. The majority of the previously mentioned clinical trial studies involved caries that had reached the dentin.(16,17)

The Vickers' method and the Knoop hardness are two techniques for assessing the remineralization of enamel that are used to gauge the microhardness of the tooth surface.By forming flu-orapatite, fluoride is a technique that encourages the remineralization of early enamel lesions(16–18). Due to the lesion's higher mineral content, preservation of Ca2+ and PO 3- causes remineralization(19). In our study from the EDX results it can be inferred that calcium levels have significantly increased in the sample which has kedo sdf gel applied on it following by the sample in artificial remineralisation solution and the control sample (figs 13,14 and 15)

The SDF/KIand SDF groups demonstrated effective remineralization, followed by the NaF group. The key finding of this experiment is that even with the addition of KI, the effect of enamel remineralization did not diminish. (20)Another factor, though, contributes to the increase in microhardness in SDF-containing groups. Silver oxide and silver iodide deposition have been linked to changes in mineral density and an increase in the microhardness of enamel and dentin, according to (12,20)Additionally, this shield stops the demineralized enamel from losing any more calcium and phosphate(21)

Additionally, silver phosphate functions as a phosphate ion reservoir, which helps fluorapatite form(21,22). The SDF's high fluoride and silver ion concentration enhances the depth and quality of remineralization.For professional fluoride application, experts advise using 1.23% APF gel and 2.26% NaF varnish, as per the ADA Evidence-based Dentistry Clinical Practice Guideline(23). Despite SDF's excellent remineralization capabilities, discoloration has been a difficult application for it. According to this study, SDF/KI, which has a high fluoride efficacy and less coloring, may be a better option than regular fluoride application treatments for preventing and inhibiting incipient caries.(24)Although there are some differences between the human and bovine teeth, it is reported that bovine teeth are suitable for replacing human teeth in comparative deminer-alization/ remineralization experiments(25). To overcome the differences in bovine enamel such as faster demineralization in enamel and chemical composition(25,26) the demineralization and remineralization procedure was carried out for a short time (120 h). In addition, the specimens were kept in artificial saliva solution, to reproduce the natural effect of remineralization by saliva in the oral cavity. However, in the future, more detailed controlled follow-up studies through research on the human body are needed.

Conclusion: In conclusion, kedo SDF is a versatile, cost-effective, and efficient agent. In comparison to an artificial remineralization solution, Kedo SDF demonstrated higher remineralization. Although more extensive clinical studies are required to confirm these remineralized materials' superiority, we contend that kedo SDF is a suitable and useful alternative agent for caries prevention and enhancement.

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