



Potential of the Combination of Nanohydroxyapatite and Salacca zalacca Skin Extract



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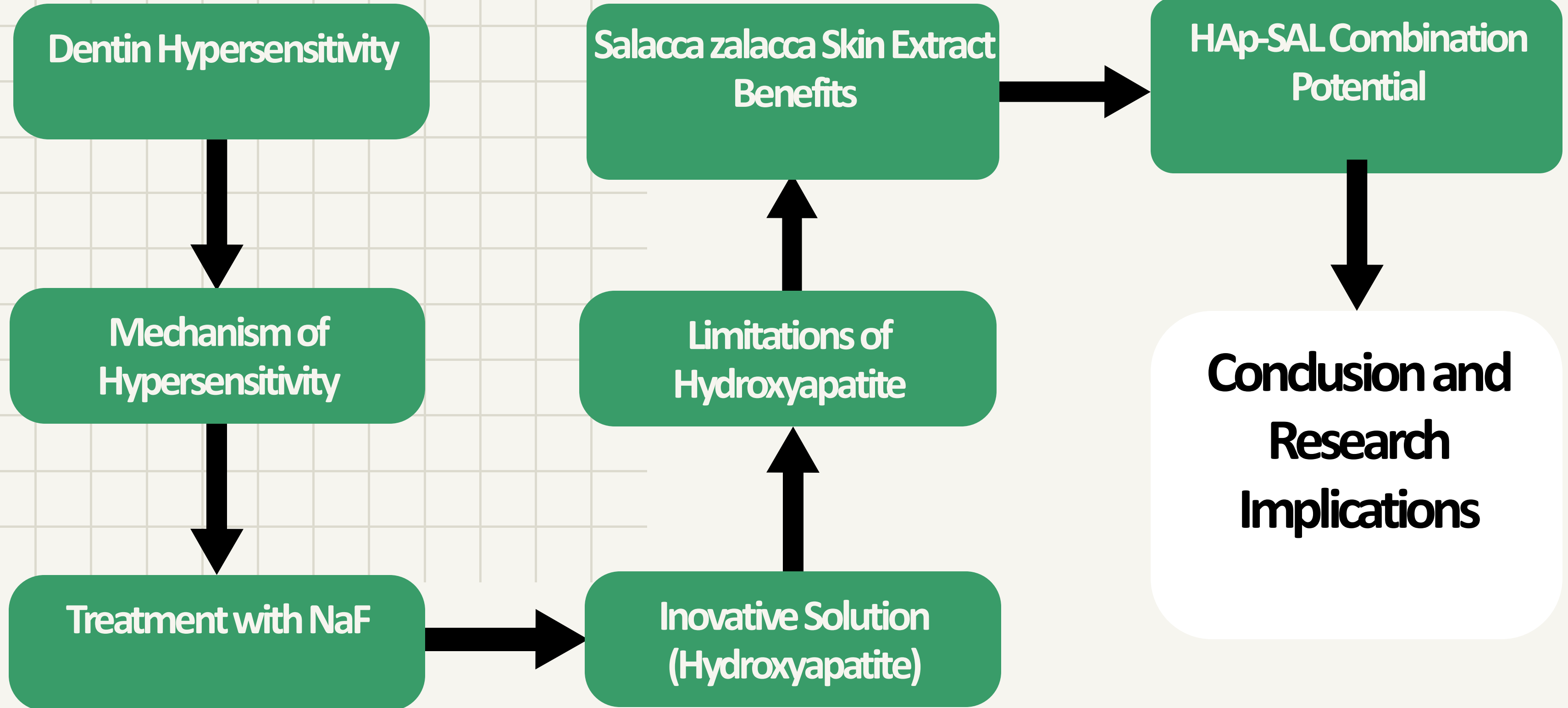
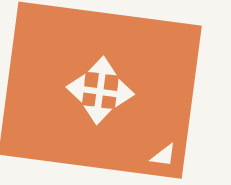


Abstract

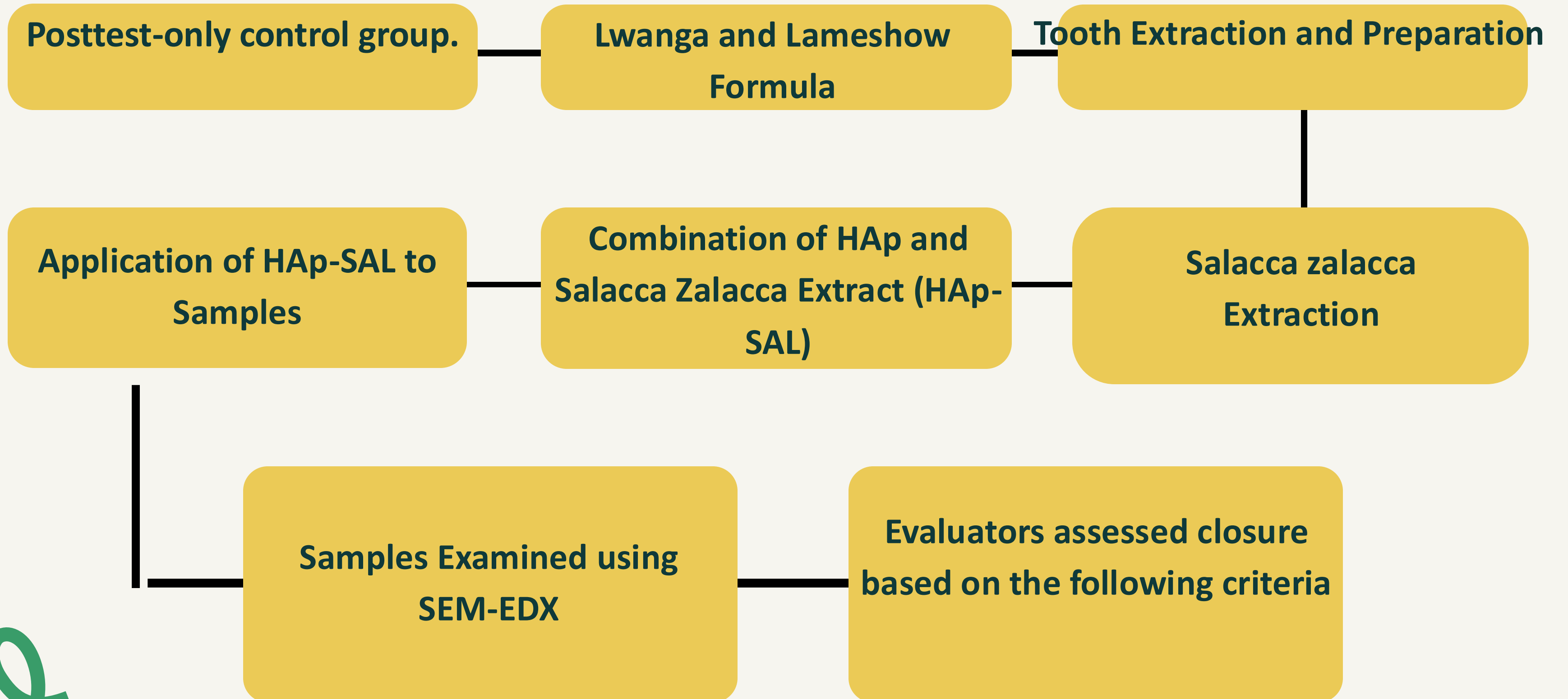


Introduction: Exposed dentinal tubules, which occur due to the loss of protective layers such as enamel and cementum, frequently cause dentin hypersensitivity. Studies are required for optimal results even though hydroxyapatite can cover exposed dentinal tubules. Extracts from the skin of *Salacca zalacca*, which are rich in antioxidants, show promise as an adjunct to enhance the effectiveness of hydroxyapatite and potentially promote bone regeneration. This study aims to determine the potential of the combination of hydroxyapatite and *Salacca zalacca* skin extract (HAp-SAL) for reducing dentin hypersensitivity by covering the dentinal tubules. **Materials and Methods:** This research was an in vitro experimental investigation. HAp-SAL was mixed in different ratios. Group A is a control, while Group B, C, and D are groupings of HAp and SAL in 2:1, 1:1, and 1:2 ratio. They were administered to dentin samples for 14 days. Scanning electron microscopy–energy dispersive X-ray (SEM-EDX) analysis was performed. The data was categorized into three categories of dentinal tubule closure. The content of minerals in dentinal tubules was also examined. The data were analyzed using the Kruskal–Wallis test to determine the differences between groups using the IBM SPSS Statistics Version 27 software. **Results:** The statistics revealed that there were significant differences ($p < 0.05$) between groups A, B, C, and D. It was demonstrated by the formation of mineral deposits on the tubule walls and the accumulation of calcium and phosphate ions surrounding the dentinal tubules that caused mineral deposits. **Conclusion:** The hydroxyapatite and *Salacca zalacca* skin extract (HAp-SAL) with 2:1, 1:1, and 1:2 ratio may be able to lessen dentin hypersensitivity by coating dentinal tubules.

Introduction

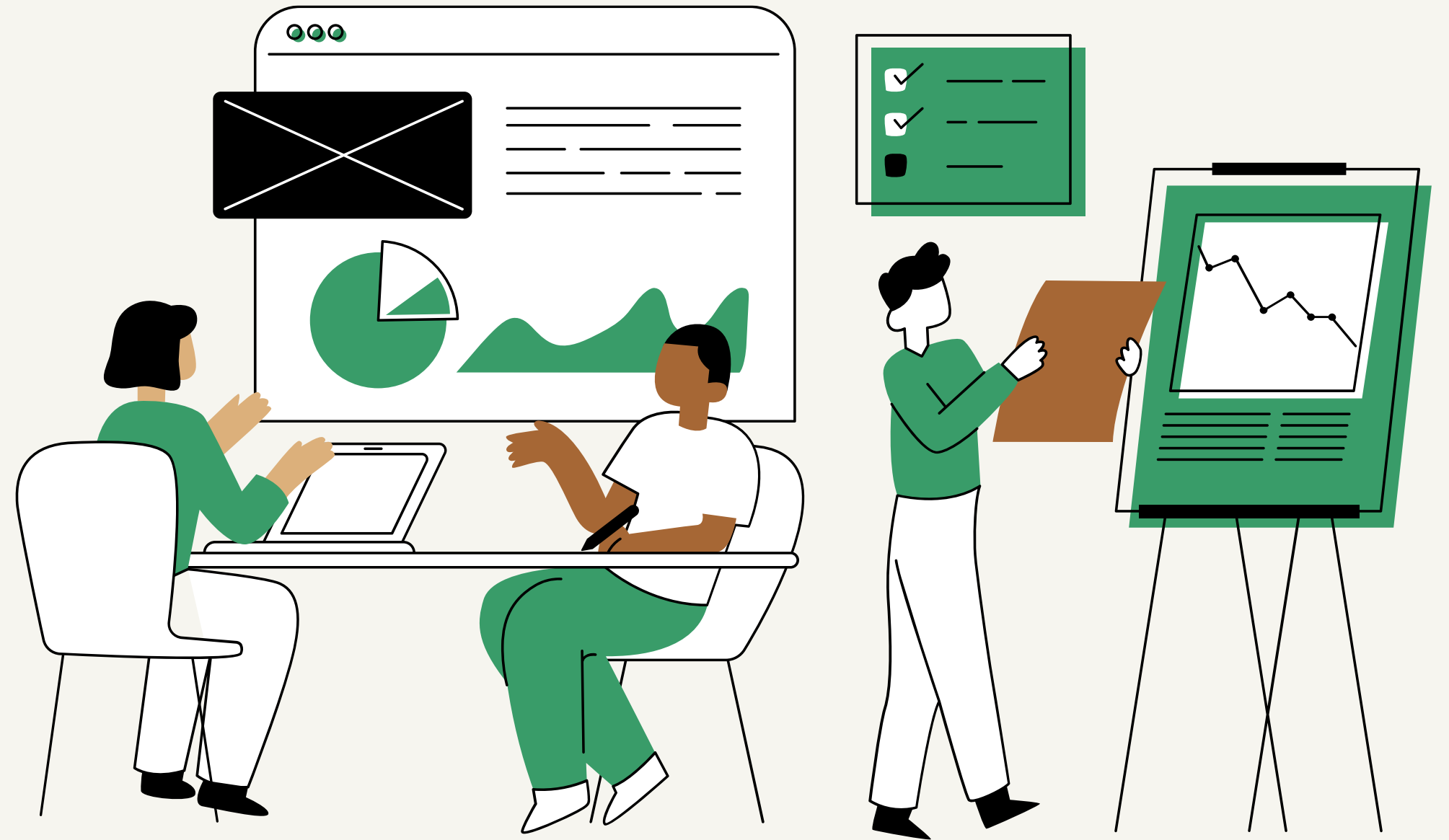


Methods



Statistical Analysis

Dentinal tubules with mineral deposits were analyzed thoroughly and divided into distinct measurement groups. as an additional step, a kappa test was used to evaluate the degree of agreement between the two observers in categorizing the data. statistical analysis was conducted with kruskal–wallis using ibm spss statistics version 27 software.



Results



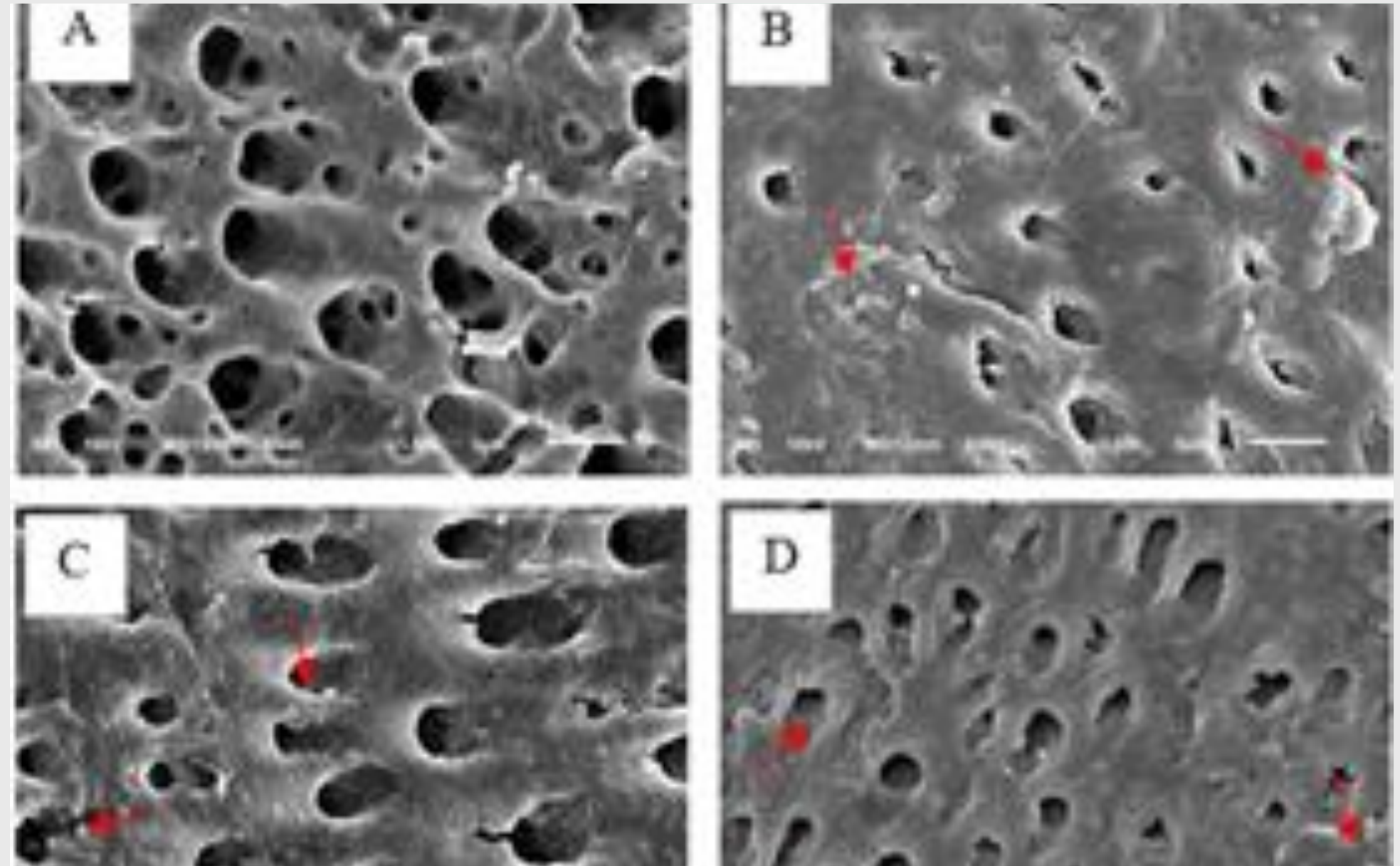
Sample	Type of Results testing/examination	Results	Testing method
Salacca salacca skin extract	Alkaloids	+	Qualitative
	Saponins	+	
	Tannins	+	
	Phenolics	+	
	Flavonoids	+	
	Glycosides	+	
	Triterpenoids	+	
Steroids	+		

A qualitative phytochemical screening of the *Salacca salacca* skin extract.

Results



The application of HAp-SAL leads to a reduction in the width of dentinal tubules due to the accumulation of mineral deposits on the dentin specimens. SEM images were analyzed based on standards.



Results



Table 2. Data analysis with Kruskal-Wallis test.

	N	p-value
Group A	4	-
Group B	4	-
Group C	4	-
Group D	4	-
Test Statistics (p)	-	0,002

*Significant $p < 0.05$

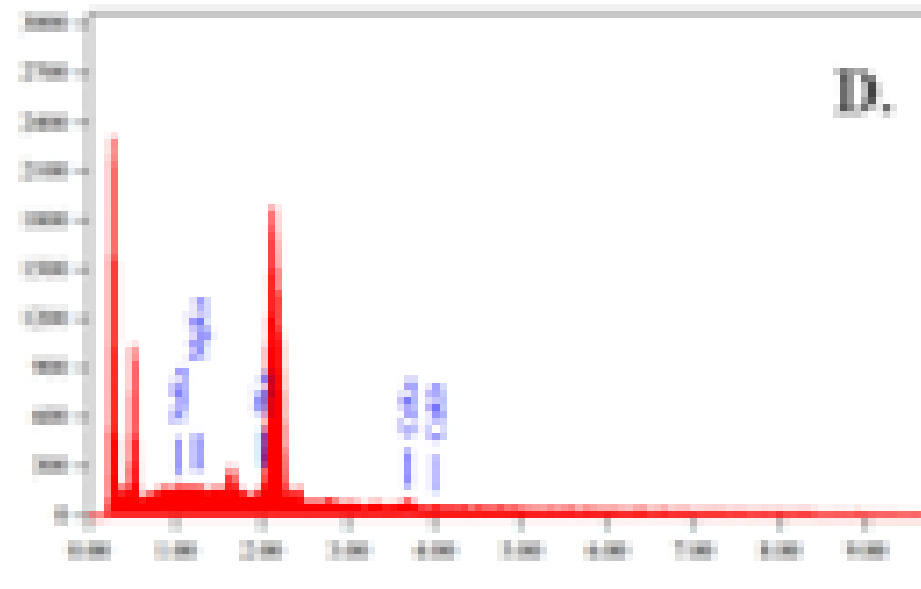
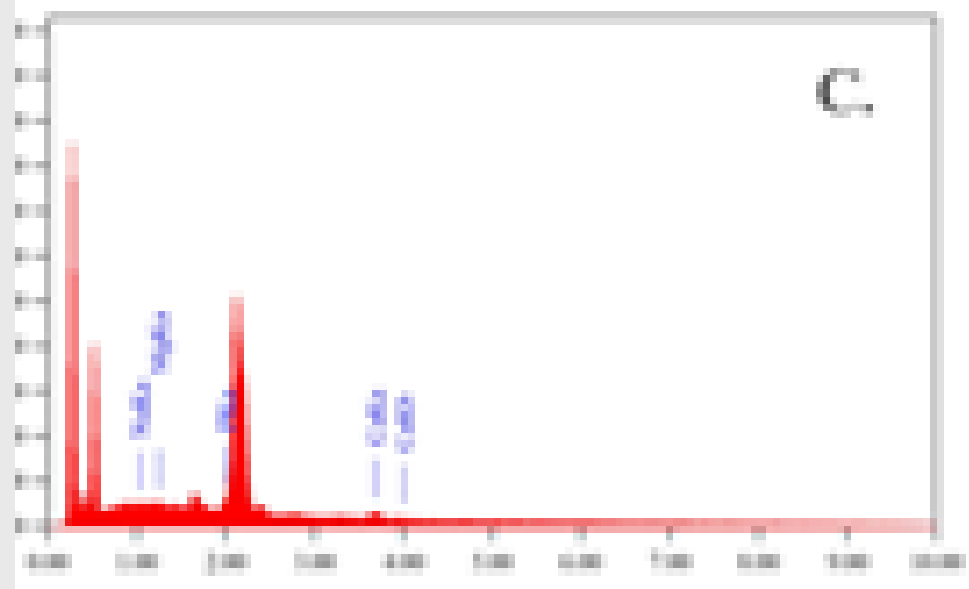
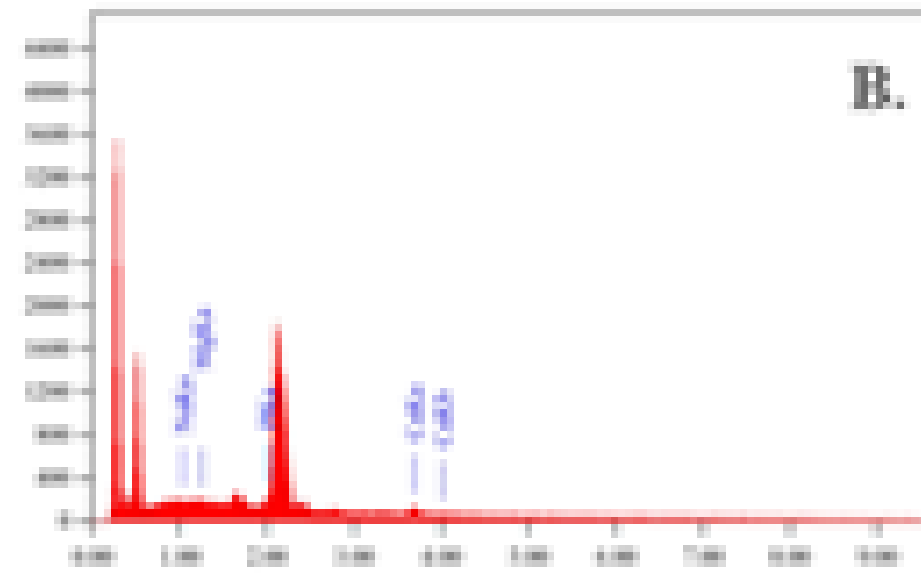
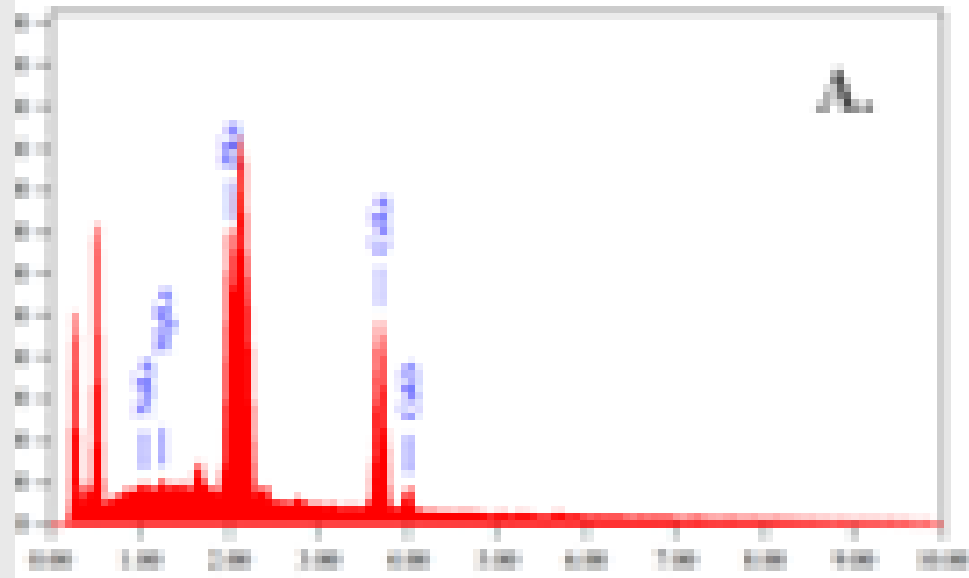
Table 3. Data analysis with Mann-Whitney test.

	A (Control)	B (2:1)	C (1:1)	D (1:2)
A (Control)	-	0,008	0,008	0,008
B (2:1)	-	-	0,008	1,000
C (1:1)	-	-	-	0,008
D (1:2)	-	-	-	-

*Significant $p < 0.05$

Data Analysis

Results



SEM-EDS analysis of dentin tubules after the application of a mixture of hydroxyapatite and *Salaca zalacca* skin extract in Groups A, B, C, and D

Discussion

- One method of lowering dentin hypersensitivity is closing the dentinal tubules.
- This study applied a mixture of hydroxyapatite and *Salacca zalacca* (HAp-SAL) to test the combination of bioactive materials for closing the tubules



- * The mixture of HAp-SAL in varying ratios (2:1, 1:1, 1:2) was tested to cover open dentinal tubules
- SEM analysis at 3000X magnification was used to observe dentinal tubules closure
- * **HAp** : Rich in calcium, phosphate, which supports pulp regeneration
- **SAL** : Contains flavonoids that enhance the strength and antioxidant properties of HAp
- * Contains flavonoids, which are strong antioxidants that enhance the effects of HAp
- Flavonoids interact with Ca^{2+} and PO_4^{3-} ions in HAp to form a protective barrier
- Hydrogen or coordination bonding reinforces the sealing of dentin

Discussion



Experimental Results of HAp-SAL Ratios

- Group A (Control) : No tubule closure, as distilled water lacks desensitizing agents
- Group B (2:1) : Showed Type 3 closure due to the higher HAp content
- Group C (1:1) : Displayed Type 2 closure, with a balanced HAp-SAL mix providing effective tubule closure
- Group D (1:2) : Demonstrated optimal Type 3 closure, suggesting SAL's unique properties improve tubule sealing

✘ SEM EDS Analysis

- SEM-EDS indicated increased Na, Mg, P, and Ca ions after HAP-SAL application
- Extensive mineral coverage and tubules sealing were observed

- ✘ • HAp-SAL forms a mineral layer that blocks external stimuli
- It shows potential as an effective desensitizing agent

✘ Study Limitations

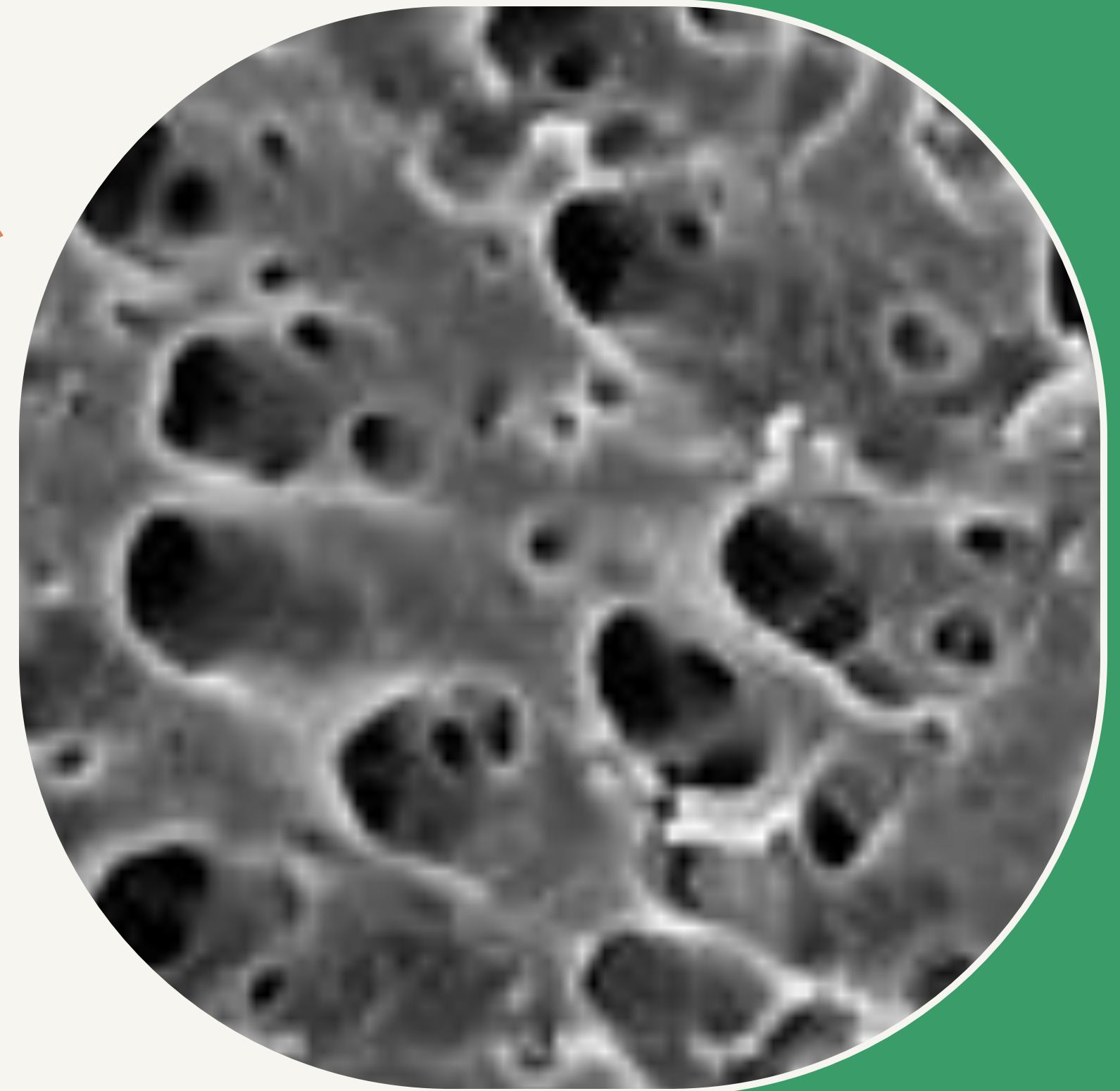
- Laboratory conditions do not fully replicate the oral cavity environment.
- Need for quantitative analysis of SAL's secondary metabolites.
- Further studies on material consistency, viscosity, and long-term effectiveness.





Conclusion

This study found that the 4% hydroxyapatite and *Salacca zalacca* skin extract mixture with 2:1, 1:1, and 1:2 ratio may be potential to lessen dentin hypersensitivity by covering the dentinal tubules. additionally, SEM analysis verified that all tested mixture ratios were successful in sealing dentinal tubules.





Authors' Contributions

EE, AEP, EF, and MG: Conceived and designed the study, conducted research, provided research materials, and collected and organised the data. EE, EF : Analysed and interpreted the data. EE and MG : Wrote the initial and final draft of the article and provided logistic support. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript



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