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Introduction

Covarine is a commonly used ingredient in tooth whitening toothpastes. Different technologies have been employed to incorporate covarine into toothpaste formulations, resulting in various forms of the product [1]. These technologies include the use of bigger flakes, two-phase pastes, and microbeads. The present investigation aimed to evaluate the behavior of covarine particles in Colgate Advanced White toothpaste [2], where covarine is present in the form of microbeads with a size of 200 microns (Figure 1.) after mixing with artificial saliva (AS) in both microfluidic mixer and Comsol simulations.

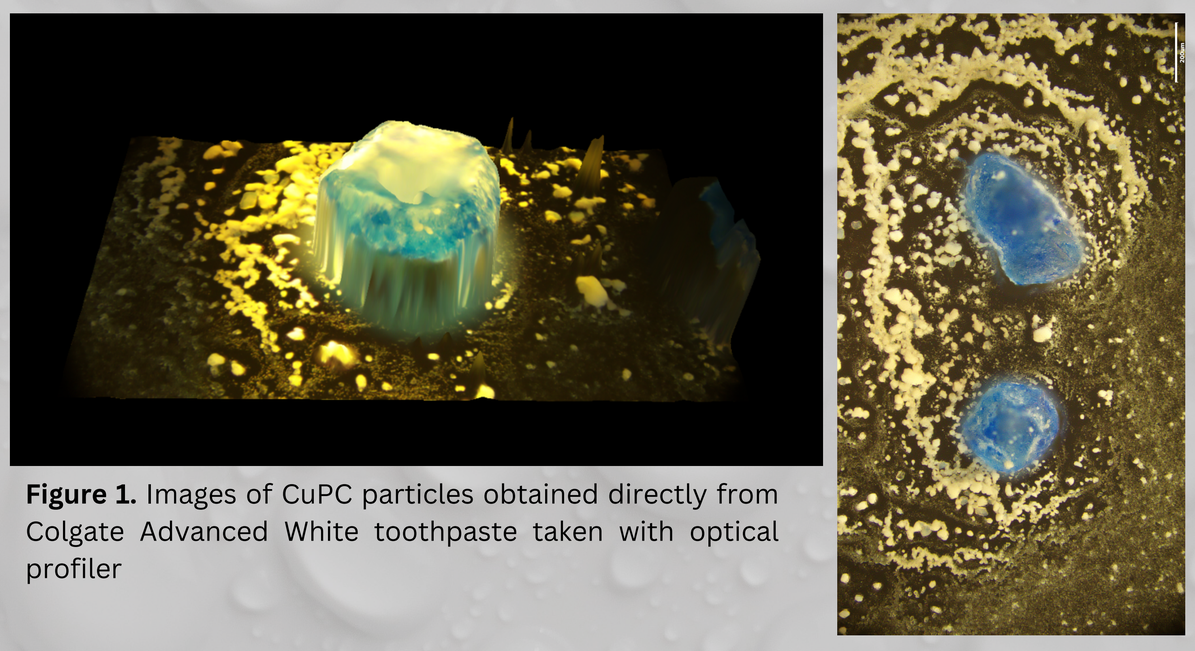

Figure 1. Images of CuPC particles obtained directly from Colgate Advanced White toothpaste taken with optical profiler

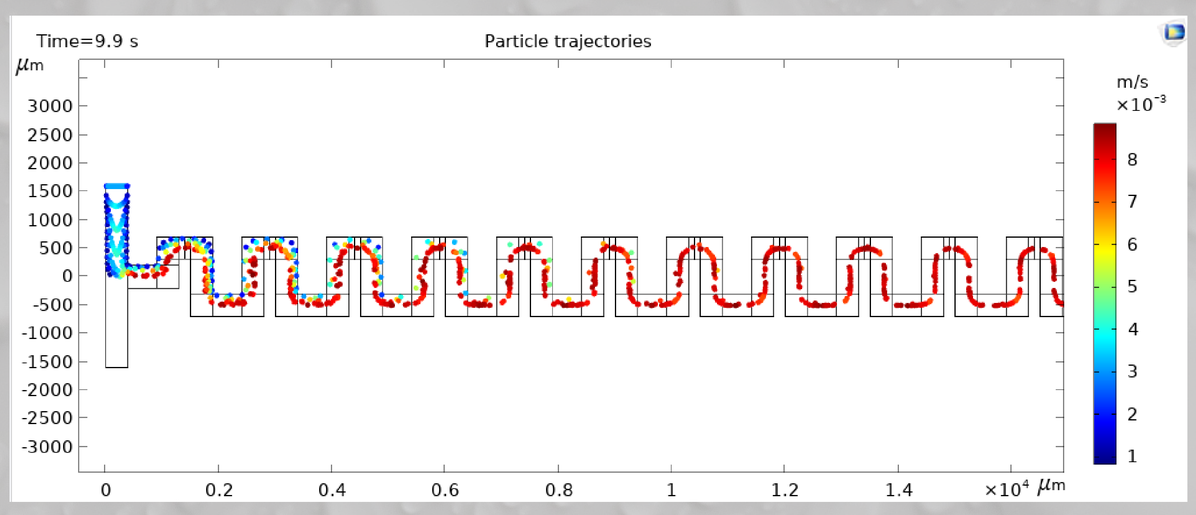

Figure 2. Particle of covarine tracing simulation results for observed MF mixer in 10th second of flow. Results proved that whole MF mixer is passable and there would not be clogging problem. Also, there can be seen that all particles got in the central flow of the MF mixer and their speed was 7-9 mm/s.

Simulation

For simulation purposes using COMSOL, parameters were obtained from the datasheets of both the toothpaste and AS. All parameters that were not available in the datasheets, such as particle size, density, viscosity, etc., were measured in the laboratory to ensure accurate simulations.

As flow through MF mixer in simulation was taken 30 µl/min as it is similar flow that happens in mouth during brushing the teeth. Observing particle trajectories in simulation results (Figure 2.) helped understanding of behavior of CuPC particles in mixer and made possible assumption that toothpaste with particle can pass through channels 400 µm x 400 µm without any material waste.

Experimental setup and results

Particle tracing in physical experiment was done also with optical profiler and syringe pump (Figure 3.). Possibility of using optical profiler is assessed by making covering layer of MF mixer from transparent PMMA [3].

Particle sizes of CuPC after passing through channels of MF mixer did not change neither did particles break. This leads to conclusion that salivary analytes stabily carry the covarine particle to the place of the delivery, at the enamel surface.

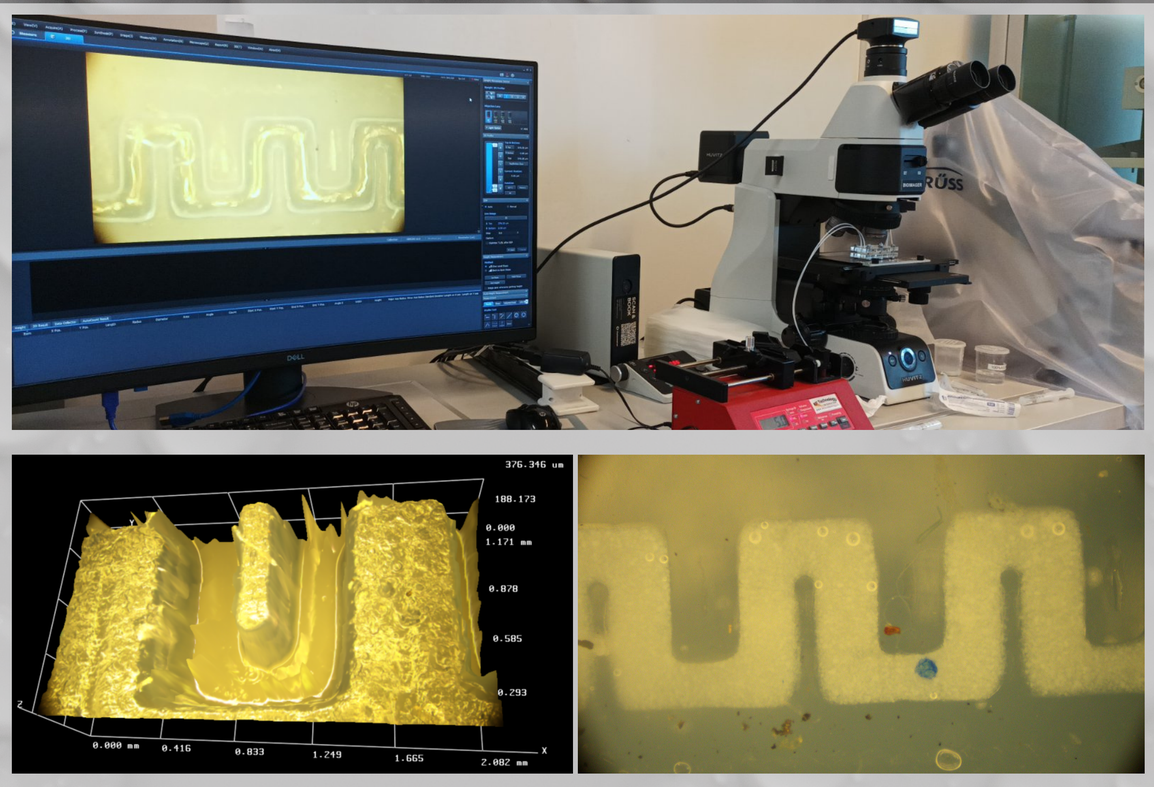

Figure 3. Images of experimental setup and some results of characterization.

Conclusion

The simulations should align with real-world experiments, strengthening our conclusions. Exploring microfluidic mixers holds potential for better salivary analysis.

To move forward, it's important to conduct further research using actual clinical samples.

References

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