

 **nanoXim**
CAREPASTE



WHITE PAPER
WHITENING

Effectiveness of nanoXIM•CarePaste on restoring dental natural whiteness

Whitening

Smile aesthetics has gained increasing importance over the years. People value the appearance of their teeth and want to achieve the perfect white smile [1]. This not only suggests good dental health, but it is also considered an ideal beauty in most cultures. For that reason, dental aesthetics can have a huge impact on confidence, self-esteem and social acceptance [2]. Therefore, consumers are looking for products that will make their **teeth whiter and brighter**, with a healthier appearance. However, a significant number of whitening products can damage tooth enamel due to the presence of highly abrasive ingredients [3]. Clinicians and formulators have been trying to find alternatives for effective whitening ingredients that do not cause tooth wear. **One of the most effective is nano-hydroxyapatite**. The latter effectively binds to tooth enamel, creating a new and uniform mineralized layer. The new white and opaque layer formed on the tooth surface blocks incoming light and reflects white light. This results in a tooth-whitening effect (Figure 1) [4].

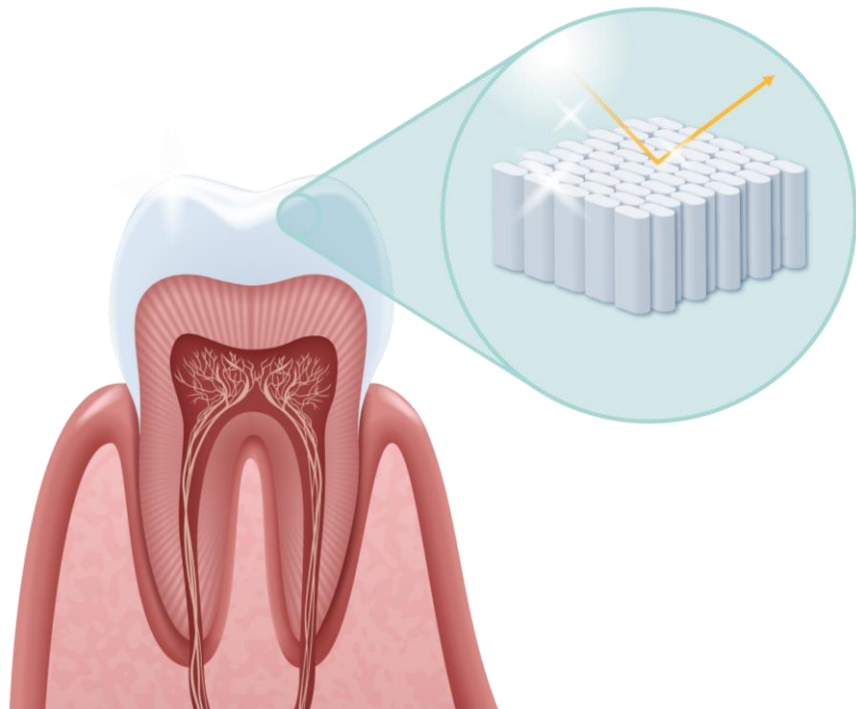


Figure 1: Nano-hydroxyapatite contributes to the formation of a uniform and smooth enamel layer. This new enamel layer is whiter, not only due to the remineralization but also related with its ability to reflect light, resulting in a tooth-whitening effect.

nanoXIM•CarePaste

The nanoXIM•CarePaste is a nano-hydroxyapatite (nHAp) ingredient produced and marketed by FLUIDINOVA. This synthetic water-based suspension ingredient has been **specifically developed for oral care applications**, such as toothpastes, gels, mouthwashes, dental floss, and other oral care products (personal and professional use). Nano-hydroxyapatite is a calcium phosphate material widely accepted in dentistry and medicine due to its exceptional biocompatibility and bioactivity. Its excellent performance is related to its nanometer size, being very similar to natural teeth and bone. nanoXIM•CarePaste contains high-purity nanoparticles under 100 nm in size, being much smaller than the dentin tubules. Therefore, they can be easily integrated inside the tubules, blocking them and **reducing the pain associated with dental hypersensitivity**. In addition, nanoXIM•CarePaste is able to bind to the dentin apatite and tooth enamel. Consequently, a new apatite layer is formed, **remineralizing the enamel, protecting the tooth surface, and restoring its natural whiteness**.

Mode of action



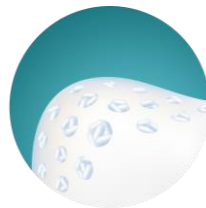
1.

Dental hypersensitivity, a short and sharp pain, prevents us from drinking hot coffee, ice cream, or even an orange juice without feeling pain. The action of certain food and drinks (hot, cold, acidic) are considered aggressions to our teeth, resulting in the exposure of dentin tubules and the underlying nerves to the external environment (the dentin loses its protective covering).



2.

HAp has a great potential in the treatment of dental hypersensitivity, as it can be incorporated inside the dentin tubules. Consequently, these become sealed and pain is reduced.



3.

As a result, a new layer is formed, remineralizing the tooth enamel and protecting the tooth surface, preventing the appearance of new cavities and making it resistant to acid attacks of our favourite meals.



4.

The deposition of HAp on the enamel surface improves its smoothness for better light reflection, and consequently brighter and whiter teeth.

The effectiveness of nanoXIM•CarePaste has been confirmed in numerous studies

Study 1

The purpose of this study was to investigate the tooth-whitening effects of mouthrinses containing different sizes of hydroxyapatite (HAp) particles after prolonged application time and compare them with a commercial whitening mouthrinse. For that, fifty bovine incisors were stained and randomly distributed into five groups: the HAp groups with 3 μm , 200 nm and 50 nm particle size (nanoXIM•CarePaste), the commercial whitening mouthrinse group and the distilled water group. The teeth underwent prolonged mouthrinse applications that were equivalent to simulated three and six-month mouth rinsing applications. Tooth color was measured and calculated before and after mouth rinsing [5].

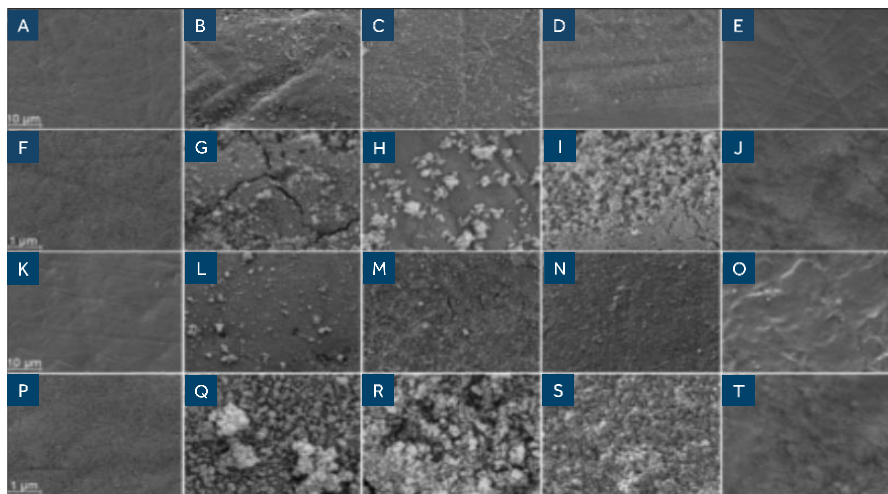


Figure 2: The mouthrinse-treated enamel surfaces were visualized at 1,000 $\times$ and 10,000 $\times$ after applications equivalent to three and six months.

A and F: untreated enamel surface at 1,000 $\times$.

K and P: untreated enamel surface at 10,000 $\times$.

B-E: the enamel of the 3 μm , 200 nm, 50 nm HAp groups and the commercial mouthrinse group at 1,000 $\times$ after applications equivalent to three months.

G-J: the enamel of the 3 μm , 200 nm, 50 nm HAp groups and the commercial mouthrinse group at 10,000 $\times$ after applications equivalent to three months.

L-O: the enamel of the 3 μm , 200 nm, 50 nm HAp groups and the commercial mouthrinse group at 1,000 $\times$ after applications equivalent to six months.

Q-T: the enamel of the 3 μm , 200 nm, 50 nm HAp groups and the commercial mouthrinse group at 10,000 $\times$ after applications equivalent to six months.

- ✓ The whitening effect of HAp mouthrinses after the prolonged application time was confirmed;
- ✓ The HAp mouthrinses exhibited similar tooth-whitening effects to the commercial whitening mouthrinse. It was also observed that the tooth-whitening performance of HAp was dependent on the particle size and application time;
- ✓ The HAp 50 nm particles (nanoXIM•CarePaste) showed better tooth-whitening performance after a longer period of mouth rinsing than the micro-sized HAp particles.

Study 2

In this study, it was evaluated the whitening efficacy of VITIS Whitening toothpaste (Dentaid S.L., Spain) that contains 3% of nanoXIM•CarePaste [6].

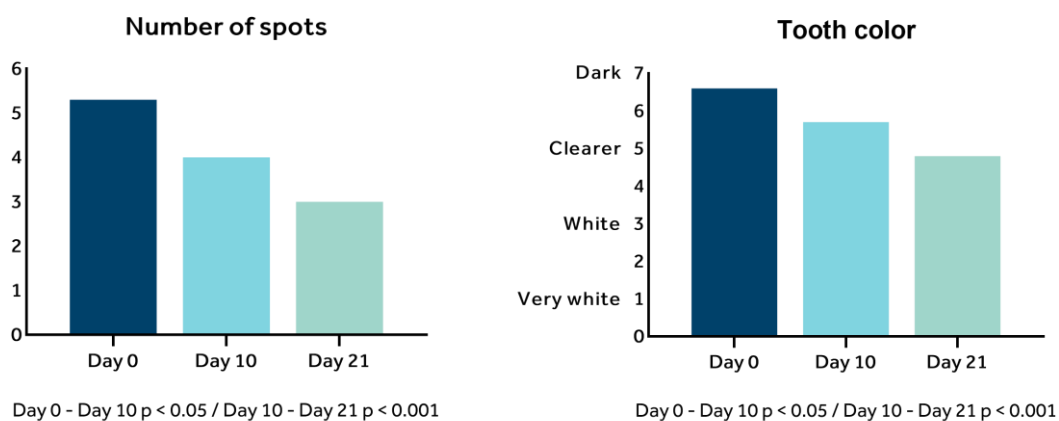


Figure 3: Whitening effect of VITIS Whitening toothpaste (containing 3% nanoXIM•CarePaste). A reduced number of dental stains and whiter teeth are achieved after ten and twenty-one days of use.

- ✓ A 24% reduction in the number of dental staining was observed in 65% of patients after ten days of use;
- ✓ A 38% reduction in the number of dental staining was observed in 75% of patients after twenty-one days of use;
- ✓ After ten days of use, it was noticed teeth whitening in 45% of patients.

Study 3

The goal of this study was to assess the postbrushing whitening effect of two experimental toothpastes containing 1 and 10 wt% nano-hydroxyapatite (nano-HAp), corresponding to 6.5 and 64.5 % nanoXIM•CarePaste, respectively [7]. For this purpose, 40 bovine incisors were assigned and each tooth was treated with the toothpaste 3 times followed by one application of hydrodynamic shear force (HSF). Tooth color changes were measured using a spectrophotometer.

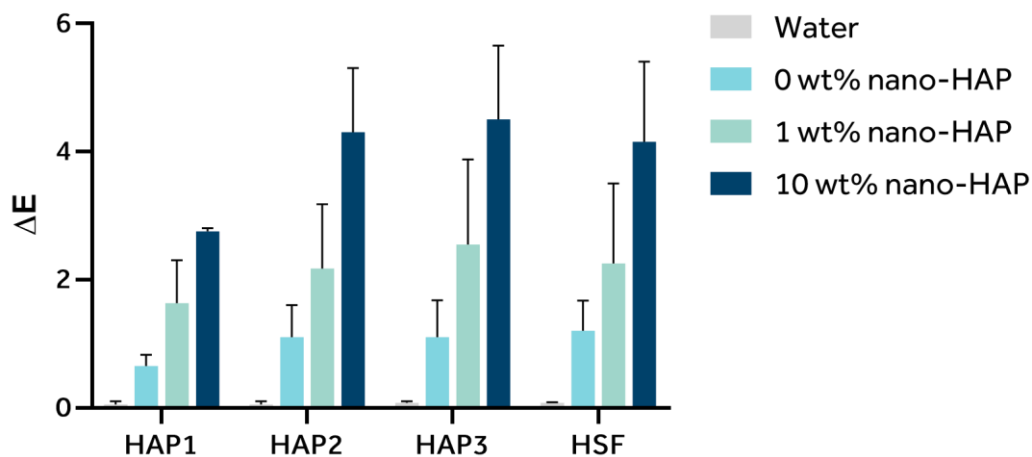


Figure 4: The average color changes (expressed as ΔE values) at each experimental time point (HAP 1: the first circle of nano-HAP application; HAP 2: the second circle of nano-HAP application; HAP 3: the third circle of nano-HAP application; HSF: application of hydrodynamic shear force).

- ✓ Both nano-HAP toothpastes had a successful post-brushing whitening effect and a good resistance to mechanical forces;
- ✓ The whitening effect seemed to be concentration-dependent, with superior color changes observed for 10 wt% nano-HAp compared to 1 wt% nano-HAp;
- ✓ After the first nano-HAP application (HAP1), the color change observed with 1 wt% nano-HAP was 151% greater than that obtained with 0 wt% nano-HAP. Furthermore, by increasing the concentration from 1 wt% to 10 wt% nano-HAP resulted in a 69% greater color change;
- ✓ In the end of the treatment (HAP3), a 132 % increase in color change was recorded when the nano-HAP concentration was raised from 0 wt% to 1 wt%. Moreover, 10 wt% nano-HAP showed a color change 76% greater than 1 wt% nano-HAP;
- ✓ It was also observed that the whitening effect had a good resistance to mechanical forces.

Study 4

Hormonal changes that occur during pregnancy can lead to oral health problems, such as gum sensitivity and an increased risk of bacterial infections. In this clinical trial, pregnant women with various oral hygiene issues participated, including those with a VAS score higher than 3 in response to an air blast stimulus [8]. Subjects were instructed to rinse Dente91 Mom Mouthwash twice a day for 30 seconds. Afterwards, they should also brush with Dente91 Mom Toothpaste for 2 minutes. This treatment was performed at least twice daily during 60 days. Incidence of dental stains and cavities was evaluated through dental x-ray at each visit.

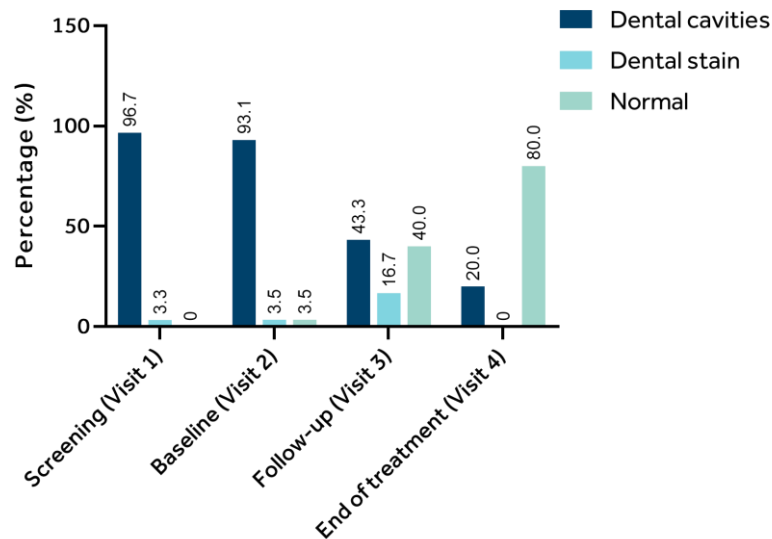


Figure 5: Percentage of patients with dental cavities and dental stain assessed with dental x-ray at each visit.

- ✓ At the end of the treatment, 76.7 % of patients were able to recover from dental cavities;
- ✓ All the patients with dental stains were able to eliminate them;
- ✓ According to these results, it can be concluded that Dente91 Mom Mouthwash and Dente91 Mom Toothpaste containing nanoXIM•CarePaste are effective and safe for use by pregnant females.

Conclusion

The studies stated in this document evidence the **success of nanoXIM•CarePaste as an oral care ingredient**, demonstrating **excellent performance in restoring the teeth's natural whiteness**. Whitening performance was also found to be dependent on particle size, with nano-sized HAp particles being the most effective.

Moreover, research demonstrates the ability of nanoXIM•CarePaste to create a new and restored tooth surface.

References:

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