



Nanozyme Therapy in Dental Practice

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Nanozymes are multi-functional nanomaterials with enzyme like activity, which rapidly took place in biomedicine. Nanozymes overcome the disadvantages of other natural enzymes such as High production costs, poor environmental stability, difficulty in storage etc. In order to highlight the contribution of nanozymes facilitating dental health we review the overall research progress of multifunctional nanozymes in various oral related diseases, including treating oral ulcers, dental caries, dental pulp diseases and peri-implantitis.¹

Treating dental caries: An experimental technique incorporating two main components: a solution which is applied to the teeth and a rinse with hydrogen peroxide that is subsequently swished in the mouth then spat out. This solution is known as ferumoxytol containing iron-oxide nanoparticles that have enzyme-like properties and therefore referred to as nanozymes.

On applying ferumoxytol onto the teeth, these nanozymes bind to the receptors present on the cell membranes of cavity-causing bacteria. The iron oxide which is present in the hydrogen peroxide rinse function as a catalyst that converts the hydrogen peroxide into oxidants. These oxidants kill the bacteria by rupturing their cell membranes and cause easy removal of plaque biofilms.²

Treating dental pulp diseases: In the treatment of dental pulp diseases, root canal therapy is the most effective approach. First tested by Koo's research team bacterial nanomaterials enhancing the antibacterial activity on the surface of complex root canals and dentinal tubules were found to be effective after a short period of local treatment (5 minutes). These iron oxide nanozymes bind to the surface of infectious dentinal tubules, and leads to the activation of hydrogen peroxide which eliminates plaque biofilms present on the surface of root canal and dentinal tubules.

Treating oral ulcers: These are chronic inflammatory diseases of oral mucosa and there is no current treatment available with any specific drug. Thus, introducing vitamin B₂ modified Fe₃O₄ nanozyme improved the healing speed of oral ulcers via anti-inflammatory and antibacterial activity. It was found that this modification enhanced their own enzyme-like activity and significantly improved its superoxide dismutase (SOD)-like activity with reactive oxygen species (ROS) scavenging ability. Cellular antioxidation experiments proved that this nanozymes can protect cells from H₂O₂, having good biocompatibility and accelerated the healing of oral ulcers in a mouse model by decreasing the secretion of local inflammatory factors and eliminating reactive oxygen species. Hence, these antibacterial agents with enzyme like activity may become an effective treatment for oral ulcers.

Preventing plaque-build up: FDA approved iron oxide nano-particles, which is delivered in a mouth rinse, can conquer the growth of dental plaque and kill bacteria which causes tooth decay. Daily application of ferumoxytol twice a day, activates hydrogen peroxide incorporated in a follow-up rinse, significantly reducing the harmful dental plaque build-up and also had a targeted effect on the bacteria which is responsible for tooth decay.³

Preventing peri-implantitis: Periimplantitis is an inflammatory reaction of the oral tissue around the implant under the action of bacteria, which is the main cause for dental implant failure. To prevent periimplantitis, patient should be aware of oral hygiene, use of ideal dental implant materials and proper implant design by the doctors. Titanium (Ti) and its alloys, are extensively used as dental implant materials as it has good biocompatibility. However, the use of titanium without any antibacterial properties generates a surface on which dental plaque accumulates easily, which is difficult to remove. The



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Titanium implants with antibacterial modification includes different coating material is favorable in hampering the growth of bacteria around implants, encouraging osseointegration, and improving the success rate of surgery. The surface of Titanium implants is modified by using photo responsive chitosan/Ag/MoS₂ and their antibacterial effect can only be activated when exposed to specific light after peri-implantitis. Nanozyme coated implants have increasingly shown excellent anti-inflammatory and antibacterial properties, and may become a potential strategy for eliminating peri-implantitis.

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