

Lattice-fringed Supramolecular Assemblies with Inflammation Microenvironment-specific Antibacterial Enhancement for Periodontitis Therapy

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Abstract

Acidic inflammatory microenvironment emerges as a pivotal pathological feature of periodontitis, but it is largely neglected. Due to the lack of specific distinguishment to this microenvironment, the current therapeutics usually cannot realize the targeted treatment. Herein, a supramolecular strategy is adopted to construct co-assemblies that can specifically respond to the inflammatory microenvironment while concurrently exerting antibacterial, biofilm elimination, and anti-inflammatory effects. By combined thermodynamic and microscopic structure characterization, sodium dodecyl benzene sulfonate (SDBS) is screened from a panel of anionic amphiphiles as the optimal candidate for co-assembly with chitoooligosaccharide (COS). The multiple noncovalent interactions drive the formation of nanospheres with ordered lattice fringes. Strikingly, SDBS/COS assembly remains inert under physiological condition of pH 7.4 to minimize oral irritation and side effects, while it becomes activated in acidic lesion sites of pH 6.5 to exert high antibacterial/anti-biofilm activity. Moreover, the assemblies effectively ameliorate inflammatory by scavenging reactive oxygen species (ROS) and modulating the Nrf2/NF- κ B pathway. *In vivo* evaluation demonstrates that this strategy achieves a comparable therapeutic effect to the clinical gold standard for periodontitis, without inducing systemic toxicity. This work establishes a facile and intelligent method for enhancing localized antibacterial activity, offering a new avenue for the comprehensive management of periodontitis.

Keywords

Hierarchical Assembly, Antibacterial Nanospheres, Multi-layered Structure, Microenvironment-responsiveness, Dental Plaque