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Recent progress in the structural modification of chitosan for applications in diversified biomedical fields

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ABSTRACT:

This article critically reviews the recent developments in the structural modifications of chitosan and its nano-structured variants produced via different techniques and their potential applications in diversified biomedical fields such as tissue engineering, drug delivery, wound healing, and gene therapy. Chitosan, a unique cationic polysaccharide, is derived from chitin, a material extracted from the shells of crabs and other sea crustaceans using alkaline deacetylation. The main advantage of using chitosan for different biomedical applications is that its properties can be tailored according to the end-use application. Moreover, it can be easily functionalized into different derivatives through chemical, radiation, and enzymatic methods. Over the last decade, polysaccharide-based functional biomaterials have been used as new drug delivery systems and highly efficient scaffolds for regenerative medicine. Because of their excellent biocompatibility, non-toxicity, antimicrobial, antifungal, and antitumor activities, chitosan-based materials in various forms, such as composites, nanoparticles, and

hydrogels, have been used as scaffolds for tissue engineering. This is a highly diversified and interdisciplinary research field requiring expertise in carbohydrate chemistry, polymer synthesis, gene therapy, cell culturing, tissue engineering, stem cell research, and therapeutic cloning. Chitosan-based hydrogels and micro/nanoparticles have also been used in designing new therapeutic systems. Therefore, in this review article, we have summarized the chemical structure and biological properties of chitosan and the state-of-the-art methods used for chitosan modification and functionalization to design solutions for a wide range of biomedical applications.