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Chapter 7: Smart and responsive drug delivery system

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Abstract:

Smart and responsive drug delivery systems (SDDSs) represent a transformative approach in modern therapeutics by enabling precise, controlled, and targeted release of drugs. Unlike conventional delivery methods, SDDSs are designed to respond to internal or external stimuli such as pH, temperature, enzymes, redox potential, light, or magnetic fields, thereby ensuring site-specific action and minimizing systemic toxicity. These systems incorporate advanced carriers including nanoparticles, liposomes, hydrogels, and dendrimers, which enhance drug stability, solubility, and bioavailability. The integration of active, passive, and dual-targeting mechanisms further improves the specificity of treatment, especially in conditions such as cancer, cardiovascular, neurological, and infectious diseases. Additionally, SDDSs support combination therapies and personalized medicine approaches by co-delivering multiple drugs or biomolecules with controlled timing and dosage. With continuous advancements in nanotechnology and biomaterials, SDDSs hold immense potential for overcoming drug resistance, enhancing patient compliance, and revolutionizing the future of precision medicine.

Keywords:

Smart drug delivery system (SDDS); Responsive drug delivery; Stimuli-responsive nanoparticles; Targeted therapy; Controlled release; Nanotechnology; Personalized medicine; Combination therapy; Biocompatible carriers.

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