

# Innovative Approaches for Modulating Gastrointestinal Absorption in Controlled Release Tablets

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**Abstract:** This review explores innovative strategies and technologies aimed at modulating gastrointestinal absorption for the controlled release of pharmaceutical compounds from tablets. The background introduces the significance of controlled release tablets in achieving sustained drug delivery. The primary objective is to highlight the critical need for inventive approaches in influencing gastrointestinal absorption, addressing current challenges in achieving precise control over drug release. The physiological considerations section provides a detailed examination of the gastrointestinal tract's structure, function, and the factors influencing drug absorption in various regions. Challenges in achieving controlled release, such as variability in gastric emptying times and pH-dependent solubility issues, are discussed in depth. Moving forward, the review delves into current approaches employed in controlled release tablets, including conventional methods like enteric coatings and modified-release formulations. Limitations associated with these conventional approaches, such as incomplete control over drug release and their lack of adaptability to individual patient variations, are critically examined. The subsequent sections explore novel strategies, including bioresponsive materials such as pH-sensitive polymers and enzyme-triggered release, carrier systems utilizing nanoparticles and lipid-based carriers, and prodrug approaches for controlled release.

Technological advances, such as microfabrication techniques and 3D printing in gastrointestinal drug delivery, are explored in detail, providing insights into their applications and successes. The article further discusses *in vitro* and *in vivo* assessment methods, including simulated gastric and intestinal conditions, tools for predicting *in vivo* performance, and various models for assessing controlled release. Challenges and future perspectives are then addressed, focusing on the need to tackle biopharmaceutical variability, personalized controlled release, and regulatory considerations. The article concludes by summarizing key findings and outlining their implications for the future of controlled release tablets. This comprehensive review contributes to the understanding of the evolving landscape of controlled release technologies, offering insights into potential breakthroughs and paving the way for future advancements in drug delivery.

**Keywords:** controlled release tablets, gastrointestinal absorption, innovative approaches, drug delivery, sustained release, bioresponsive materials, personalized medicine, technological advances.

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