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Advancements in Solid Dispersion Technology for Enhancing Bioavailability of Poorly Soluble Drugs: A Comprehensive Review

Ms. Rutuja Narendra Dohatare, Dr. Pankaj M. Pimpalshende, Ms. Samiksha Shrikant Chimalwar
Hi-Tech College of Pharmacy, Padoli Phata, Morwa, Chandrapur

Abstract: *Poor aqueous solubility is a major challenge limiting the oral bioavailability and therapeutic efficacy of many drug candidates, particularly those categorized under Biopharmaceutics Classification System (BCS) Class II and IV. Solid dispersion technology has emerged as a promising strategy to overcome solubility barriers by dispersing poorly soluble drugs in inert carriers, thereby enhancing dissolution rates and absorption. This comprehensive review presents an in-depth analysis of the fundamental concepts, types of solid dispersions, and the role of various carriers including synthetic, natural, and lipid-based excipients. Preparation methods such as solvent evaporation, hot melt extrusion, spray drying, and supercritical fluid technology are discussed along with their respective advantages and limitations. The review further explores physicochemical characterization techniques, stability issues, and recent advances including nanotechnology-enabled solid dispersions, novel carriers, controlled release systems, and green processing methods. Despite notable progress, challenges related to physical stability, scale-up, and regulatory acceptance persist. Future perspectives highlight the integration of solid dispersions with other drug delivery systems, personalized medicine approaches, and the application of artificial intelligence for formulation optimization. This review underscores the potential of solid dispersion technology to revolutionize oral drug delivery by improving the bioavailability of poorly soluble drugs and guiding future research and development efforts*

Keywords: Solid dispersion, poorly soluble drugs, bioavailability enhancement, drug solubility, hot melt extrusion, nanotechnology, drug carriers, oral drug delivery, formulation strategies, pharmaceutical technology

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