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Development of Hierarchically Structured Tablets with 3D Printed Inclusions for Controlled Drug Release

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Abstract : Drug dosage forms consisting of multi-unit particle systems (MUPS) for modified drug release provide a promising route for overcoming the limitation of conventional tablets. Despite the conventional use of pellets as units for MUP systems, 3D printed polymers loaded with a drug seem like an interesting candidate due to the control over dosing that 3D printing mechanisms offer. Further, 3D printing offers high flexibility and control over the spatial structuring of a printed object. The final MUPS tablets include PVP and HPC as granulate with other excipients, enabling the compaction process of this mixture with 3D printed inclusions, also termed minitablets. In this study, we have developed the multi-step production process for MUPS tablets, including the 3D printing technology. The MUPS tablets with incorporated 3D printed minitablets are a complex system for drug delivery, providing modified drug release. Such structured tablets promise to reduce drug fluctuations in blood, risk of local toxicity, and increase bioavailability, resulting in an improved therapeutic effect due to the fast transfer into the small intestine, where particles are evenly distributed. Drug loaded 3D printed minitablets were compacted into the excipient mixture, influencing drug release through varying parameters, such as minitablets size, matrix composition, and compaction parameters. Further, the mechanical properties and morphology of the final MUPS tablets were analyzed as many properties, such as plasticity and elasticity, can significantly influence the dissolution profile of the drug.

Keywords : 3D printing, dissolution kinetics, drug delivery, hot-melt extrusion
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