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Development of rapidly dissolving 3D-printed tablets for personalized medicine by applying acid-base supersolubilization (ABS) principle

Abu Serajuddin

St. John's University, Queens, NY, USA

In recent years, there has been much interest in three-dimensional (3D) printing by fused deposition modeling (FDM) for the development of pharmaceutical dosage forms like tablets as it can provide personalized, patient-centric, and on-demand medications. However, one major hurdle in the development of such products is slow and incomplete drug release from dosage forms. While most drugs need to be released and absorbed rapidly after oral administration for optimal therapy, the FDM 3D printing results into slow-release tablets since they are produced by layer-by-layer deposition of nonporous filaments, where drugs remain trapped within the tablets and dissolve by slow erosion only. Other issues with FDM 3D printed tablets are lack of drug-polymer miscibility, high processing temperature, and poor printability. This presentation will address how all these issues may be resolved by using a novel physicochemical principle called acid-base supersolubilization (ABS), where the solubility of poorly water-soluble weakly basic drugs may be increased greatly by interaction with weak acids, thus ensuring rapid drug release from 3D-printed tablets. It also increased drug-polymer miscibility and reduced processing temperatures. For example, amorphous filaments of a basic drug, haloperidol, was produced by heating its mixtures with glutaric acid or malic acid along with Kollidon® VA64 as the carrier. Extrusion of filaments and printing of tablets were performed at relatively low temperatures of 115 and 120 °C, respectively. Although the filaments of haloperidol-Kollidon® VA64 mixtures by themselves are not printable, they could be printed in presence of acids. Drug release rates from the formulations at pH 2 and 6.8 were rapid and complete (<1 h).