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EDITORIAL

3D Printing of Pharmaceutical and Medical Applications: a New Era

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Three – dimensional (3D) printing has revolutionised the field of pharmaceutical dosage forms. 3D printing is a process used to fabricate three dimensional objects based on the layer – by - layer deposition of materials on a computer controlled platform. In the last 10 years researchers have utilized 3D printing technologies to address the current limitations in manufacturing of drug products and challenges in the treatment of patients. The shift from bulk manufacturing of drugs, towards the design and production of personalized medication and dose tailoring, requires the optimization of different 3D printing technologies and processing of suitable materials. The introduction of Aprecia's Zipdose technology for the commercialization of Spritam®, the first 3D printed orally disintegrated tablet, has opened the pharmaceutical industries eyes to new treatment options for patients.. 3D printing is anticipated to facilitate more effective treatment by taking in account the individual patient profiles and producing personally tailored medications, adjusting factors such as dosing and release profile, based on the needs of the individual.

In this special issue we provide a comprehensive discussion on 3D printing technologies used for soft materials, food, pharmaceutical dosage forms and biomedical applications. In addition, case studies of 3D printing technologies are presented related to filament design, processing of thermal labile drugs and drug discovery screening.

Boyd et al., reviewed a range of 3D printing technologies such as inkjet printing, binder jetting, selective laser sintering (SLS), stereolithography (SLA) and fused deposition modelling (FDM). The article presents the operational principles and discusses the advantages and limitations of each technology in relation to the processed materials. The authors provide an in-depth discussion on the challenges of the 3DP technologies associated with technical processing, regulatory and material issues.

Jachowicz et al., presented the current achievements in 3D printing technologies related to multifunctional drug delivery systems with accelerated release, adjustable and personalized dosage forms, implants and phantoms corresponding to specific patient anatomy as well as cell- based materials for regenerative medicine. The article includes a detailed history on 3D printing and presents a timeline of several 3D printed products developed by different techniques. Furthermore, the article covers important printing parameters such as filament, geometry and print heads for the development of finished designs. A specific section is dedicated to biomedical applications including wound dressing, implants, prostheses, medical phantoms and organs – on – chip applications.

A very interesting study was presented by Qi et al., who developed a screening process for the selection and design of filaments for Fusion Deposition Modelling (FDM) with suitable mechanical properties. The authors developed a protocol using the force/distance plots produced by commercial filaments as a control, followed by correlation analysis and principle component analysis in order to determine the printability of the extruded pharmaceutical filaments. This work demonstrated the ability to predetermine the printability of extruded filaments into an FDM printer.

Seidlitz et al., designed immediate release 3D-printed tablets produced via FDM by processing a thermos – sensitive drug. The work showed for first time the use of FDM for immediate release applications using pharmaceutical grade polymers, where the tuning of tablet porosity had a significant effect on the drug release. The process was optimized to maintain the stability of a heat sensitive drug and demonstrated the diversity of FDM printing.

Alexander et al., designed and printed cell exclusion spacers with various geometries for use in cell motility studies, allowing on-demand assays. The study revealed that cell

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migration distances were significantly reduced and for the customized plates the vascular endothelial cells reached confluency and completely filled the voided spacer regions within the first 3 days. The 3D printed structures demonstrated great potential for studying cell motility, migration/invasion, and complex multi-cell interactions.

3D printing is a fascinating technology which will revolutionized the pharmaceutical and medical fields in the next decade. We are still in the advent of the 3D printing era and there are still many more applications to discover. The introduction of new 3D printed medicinal products combined with advances in printing technologies will transform the landscape of patient treatment and the healthcare as a whole.

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