Development and characterization of gastroretentive drug delivery formulations produced *via* FDM 3D-printed coaxial semi-solid extrusion systems

Falcone Giovanni[ab], Saviano Marilena[ab], Aquino Rita P.[a], Del Gaudio Pasquale[a], Russo Paola[a]
[a] Department of Pharmacy, University of Salerno, Fisciano, SA, Italy
[b] PhD Program in Drug Discovery and Development, University of Salerno, Fisciano, SA, Italy

To date, 3D Printing techniques are greatly investigated due to their flexibility, low-cost, and on-demand production, properties that make them suitable for the development of "Personalised medicines", one of the most important goals of pharmaceutical field [1-2].
In this work, two different 3D-Printing technologies, i.e. Fused Deposition Modelling (FDM) and Semi-Solid Extrusion (SSE), were combined in an unconventional production process. Exploiting the high definition of FDM, a co-axial extruder was printed to produce formulations customizable in shape, dimensions, buoyancy, and drug content, *via* the milder SSE. SSE technology was used for the co-extrusion through the printed extruder of an alginate solution and a thickened solution containing divalent cations for the alginate cross-linking: the alginate and the calcium chloride solutions were extruded simultaneously, coming into contact immediately after the extrusion.
Preliminary studies on sodium alginate feed solution (extruded in the outer channel), and on hydroxyethyl cellulose gel containing calcium chloride (extruded in the inner channel) have been carried out to understand the influence of each formulation and process parameters on the properties of the extruded pharmaceutical forms
The feeding gels leading to the best blank formulation (Sodium Alginate 6%, calcium chloride 0,1M in 5% w/v HEC gel) were used for the production of Propranolol Hydrochloride floating formulations, by adding the drug in a different ratio in the HEC gel, to evaluate the influence on printability and release profiles. Moreover, the drug-polymer interactions were studied *via* DSC and FT-IR and the impact of formulation size on drug release profiles was evaluated, showing the possibility of loading different amounts of API, according to patients' needs.

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[2] Vithani, K., Goyanes, A., Jannin, V., Basit, A. W., Gaisford, S., Boyd, B. J. (2019). An overview of 3D printing technologies for soft materials and potential opportunities for lipid-based drug delivery systems. Pharmaceutical research, 36(1), 4.

Giovanni Falcone
Giovanni Paolo II street, Fisciano, Salerno, Italy
FLCGNN95B25F912L
3203874123
gifalcone@unisa.it

Marilena Saviano
Giovanni Paolo II street, Fisciano, Salerno, Italy
SVNMNL92O48A509H
3334290117
masaviano@unisa.it