Could microfluidics become accessible and revolutionize the manufacturing of nanomedicines?

Mattia Tiboni

Department of Biomolecular Sciences, University of Urbino Carlo Bo, Urbino (PU), Italy

The manufacturing of innovative drug delivery systems often collides with the obstacle of the scale-up process to translate from the bench to the clinic. Microfluidics could help to overcome the problem thanks to high reproducibility, high production rate, low batch-to-batch variation, and control over carrier characteristics [1].

Nevertheless, microfluidic systems are still expensive and need device fabrication expertise to tune their characteristics based on the needs creating a barrier for new users. 3D printing technology promises to be an enabling new field that helps to overcome these drawbacks expanding the realm of microfluidics [2].

Here, we developed two different microfluidic chips relying on a “zigzag” bas-relief and on “split and recombine” channels to obtain an effective passive micromixing. After computational fluid dynamic studies to confirm the mixing potential, they were 3D printed in polypropylene using the fused deposition modeling technique. Cannabidiol loaded PLGA nanoparticles and liposomes were efficiently manufactured as model nanocarriers with tunable characteristics based on microfluidic production parameters.

These polypropylene-based microfluidic chips could represent an affordable and low-cost alternative to common microfluidic devices for the effective manufacturing of nanomedicines after appropriate tuning of manufacturing parameters. This has the potential to widen accessibility further by eliminating the design barrier in addition to the fabrication barrier largely limiting access to microfluidic technology at present. This is the first approach to this opportunity that can lead to further designs to improve the characteristics of the microfluidic system [3].

References

1. Zhao, X., Bian, F., Sun, L., Cai, L., Li, L., Zhao, Y., (2020). Microfluidic Generation of Nanomaterials for Biomedical Applications. Small 16, 1901943.

2. Pranzo, D., Larizza, P., Filippini, D., Percoco, G., (2018). Extrusion-Based 3D Printing of Microfluidic Devices for Chemical and Biomedical Applications: A Topical Review. Micromachines 9, 374.

3. M. Tiboni, M. Tiboni, A. Pierro, M. Del Papa, S. Sparaventi, M. Cespi, L. Casettari, (2021) Microfluidics for nanomedicines manufacturing: An affordable and low-cost 3D printing approach, Int. J. Pharm. 599, 120464.