Title: 3D printing of microfluidic device for the preparation of lipidic nanoparticles

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18-α-glycyrrhetinic acid (GA) exhibits a broad spectrum of biological and pharmacological activities such as anti-inflammatory and antioxidant effects (1). Its hydrophobicity makes its adsorption and bioavailability very low so, its inclusion in a drug delivery system is a strategy to overcome these drawbacks. Microfluidics is an innovative technique useful to produce drug delivery systems such as liposome (2); It needs dedicated chips that can be printed with modern fusion deposition modeling 3D printer (3).
A T-shaped microfluidic chip was printed using polylactic acid (PLA). Pumping lipids and the drug through the chip, ethanolic GA-loaded liposomes were manufactured. They were characterized for their average size, polydispersity index, encapsulation efficiency and stability over time. Moreover, they were analyzed by TEM, FTIR and mDSC. In vitro cytocompatibility was evaluated on HaCat. Drug release and permeation were evaluated using Franz cells with cellulose and skin mimicking membranes after hydrogelation with xanthan gum
With optimized microfluidic parameters, we obtained liposomes with a size of 202±5.2 nm, a narrow size distribution and good stability over a period of 30 days. We were able to reach a drug encapsulation efficiency of 63.15±2.2% and we demonstrated an optimal cytocompatibility. In vitro permeation studies showed a 10 times higher amount of drug permeated through skin mimicking membrane from liposomal hydrogel compared to GA-saturated hydrogel.
Using our biodegradable and cost-effective PLA 3D-printed microfluidic chip we demonstrated the effective production of GA-loaded liposome with high encapsulation efficiency. The chip represents an affordable microfluidic device with an easy fabrication, very low cost and potential scalability for higher production rates.

References: (1) Pastorino G, Cornara L, Soares S, Rodrigues F Oliveira. M.B.P.P. 2018:2323–2339. (2) Martins J P, Torrieri G, Santos H A. Expert Opin. Drug Deliv. 2018:469-479. (3) Mattia Tiboni, Serena Benedetti, Athanasios Skouras, Giulia Curzi, Diego Romano Perinelli, Giovanni Filippo Palmieri, Luca Casettari, Int J of Pharm, 2020:584, 119436