3D PRINTING OF A MICROFLUIDIC DEVICE FOR THE PREPARATION OF LIPIDIC NANOPARTICLES

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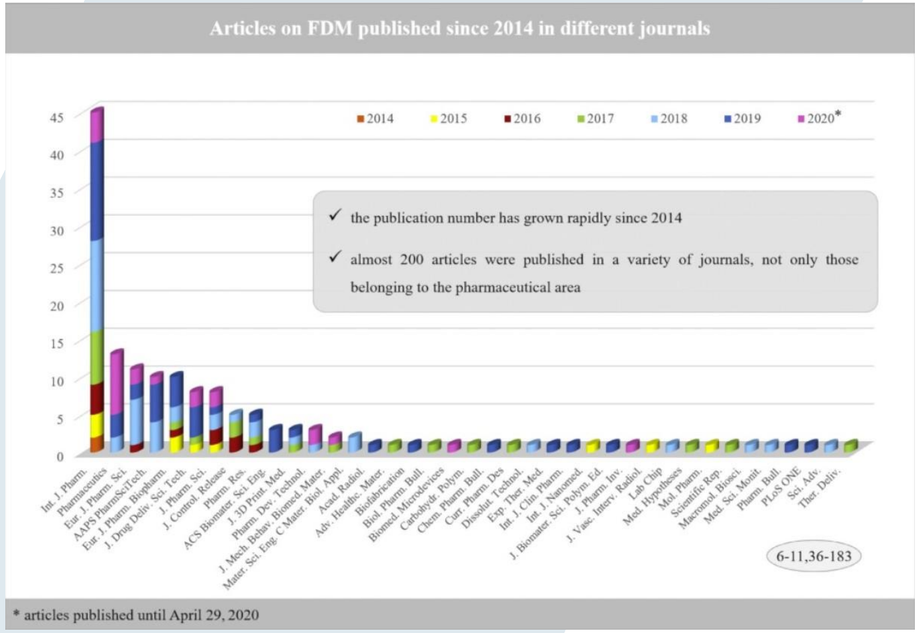
Fused deposition modeling (FDM) 3D printing

- 3D printing technology that allow to print objects layer by layer
- Increasing interest on its application in the pharmaceutical field during the last ten years
- Production of pharmaceutical devices (patches, microneedles, stents, films, etc)
- Direct production of pharmaceutical forms (tablets, suppositories)
- Personalized medicine (Form, dosage, etc)

But it is not only direct production of pharmaceutical forms or devices….

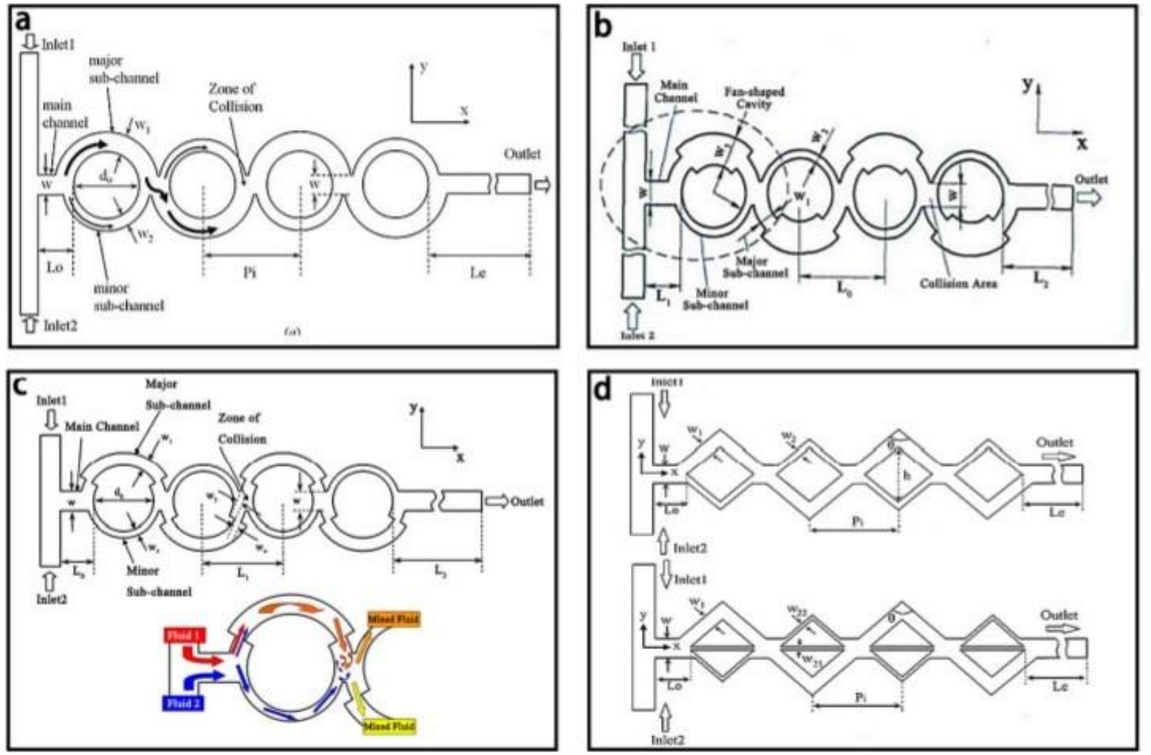


© Makerbot

A. Melocchi, M. Uboldi, M. Cerea, A. Foppoli, A. Maroni, S. Moutaharrik, L. Palugan, L. Zema, A. Gazzaniga, A Graphical Review on the Escalation of Fused Deposition Modeling (FDM) 3D Printing in the Pharmaceutical Field, J. Pharm. Sci. (2020). https://doi.org/10.1016/j.xphs.2020.07.011.

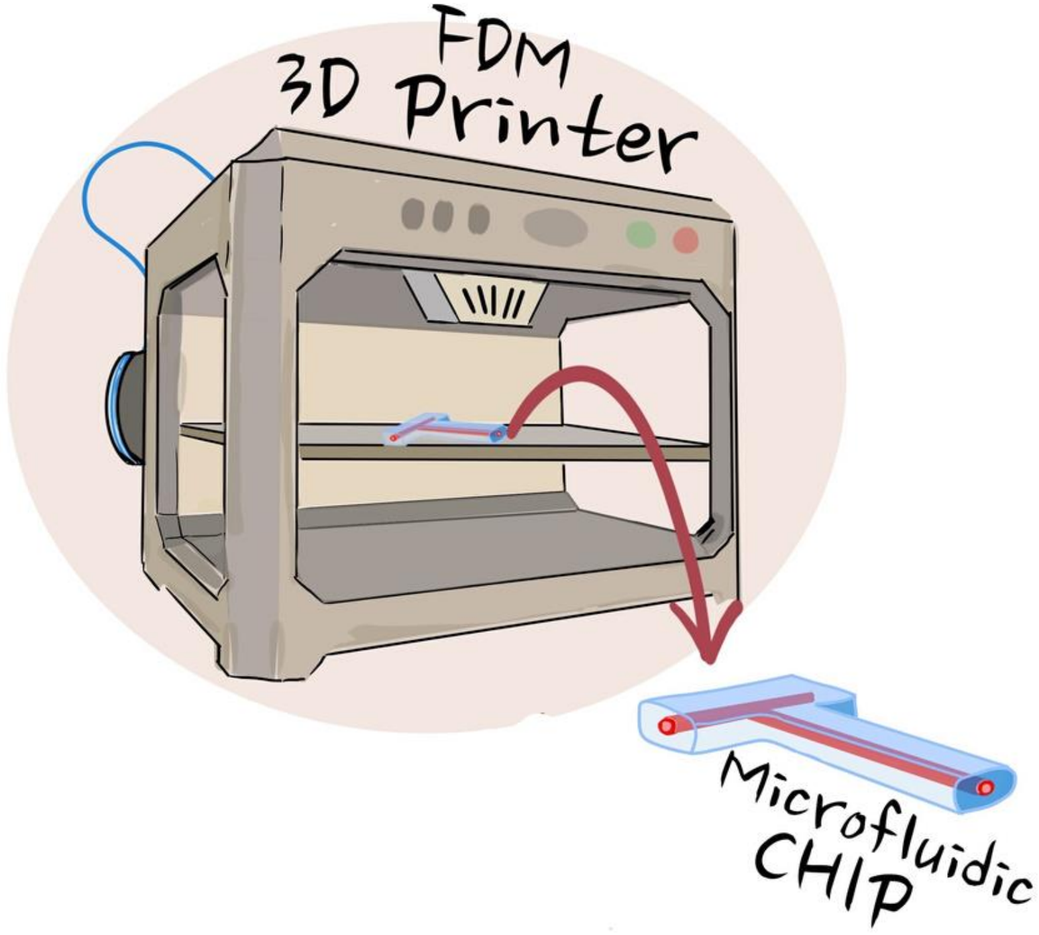
Microfluidics

- Controllable and scalable technique for the production of nano or micro particles
- Precise control of micromixing under laminar flow
- One-step production
- High production rates
- Higher drug encapsulation compared to conventional techniques



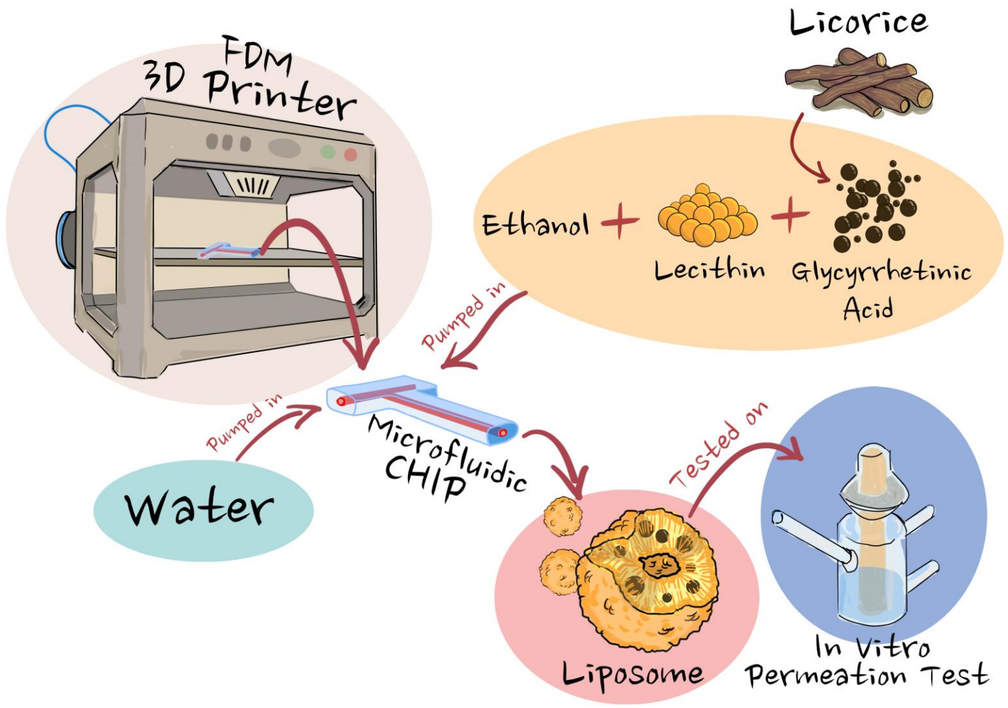
Why is convenient to produce 3D printed microfluidic chips?

- Device design by CAD software
- Material choice
- Low cost
- Complete personalization of the device
- Easy to produce
- Good resolution



A case study

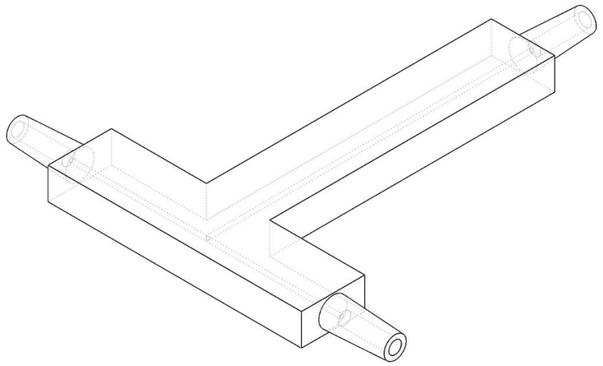
3D-printed microfluidic chip for the preparation of glycyrrhetinic acid-loaded ethanolic liposomes



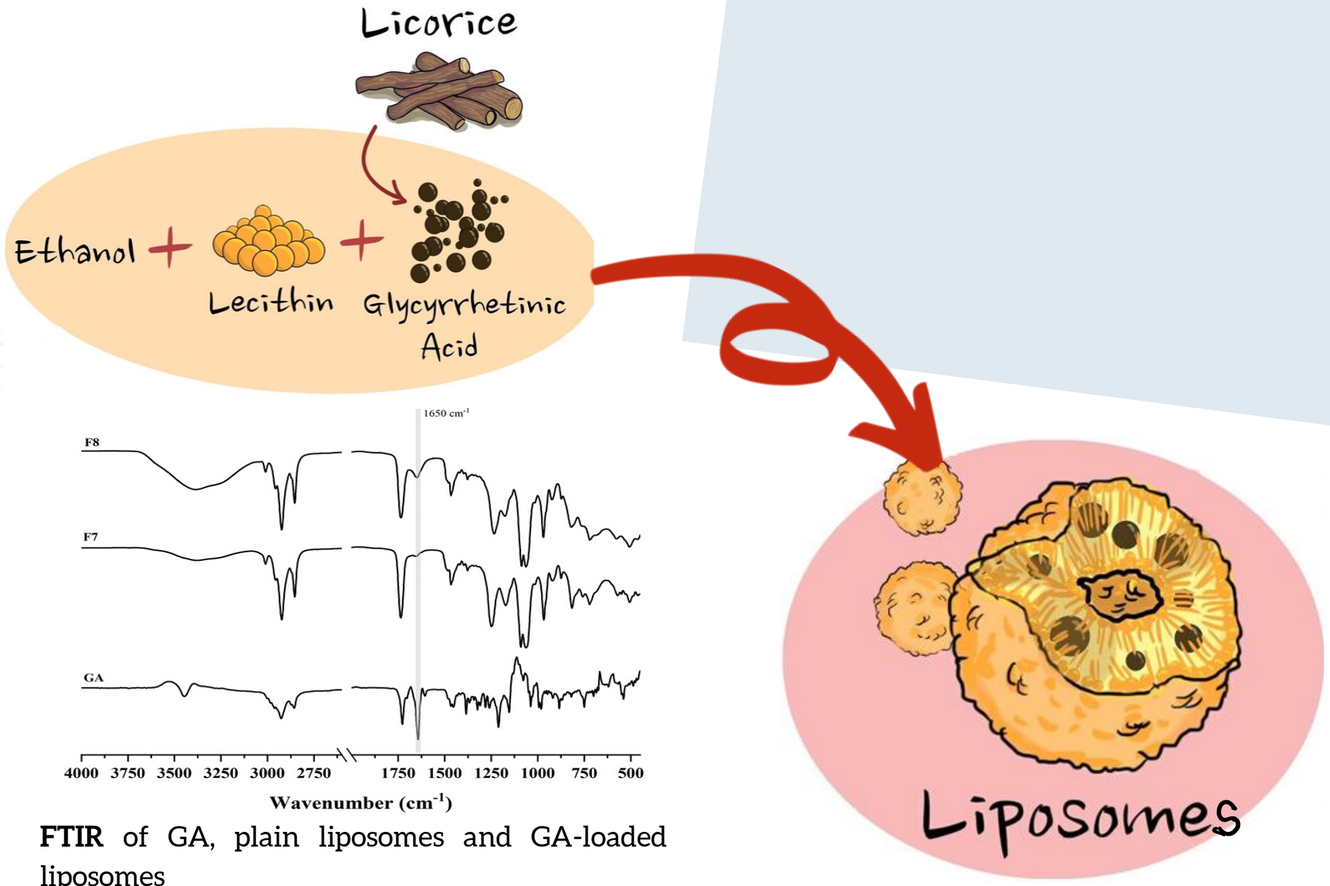
M. Tiboni, S. Benedetti, A. Skouras, G. Curzi, D. Romano Perinelli, G. Filippo Palmieri, L. Casettari, 3D-printed microfluidic chip for the preparation of glycyrrhetinic acid-loaded ethanolic liposomes, Int. J. Pharm. (2020) 119436. https://doi.org/10.1016/j.ijpharm.2020.119436.

BACKGROUND

- Glycyrrhetinic acid is an active compound present in licorice
- It showed anti-inflammatory and anti-oxidant activities when applied topically
- Ethosomes are known to have an increased permeation through stratum corneum
- Production using 3D printed microfluidic chip

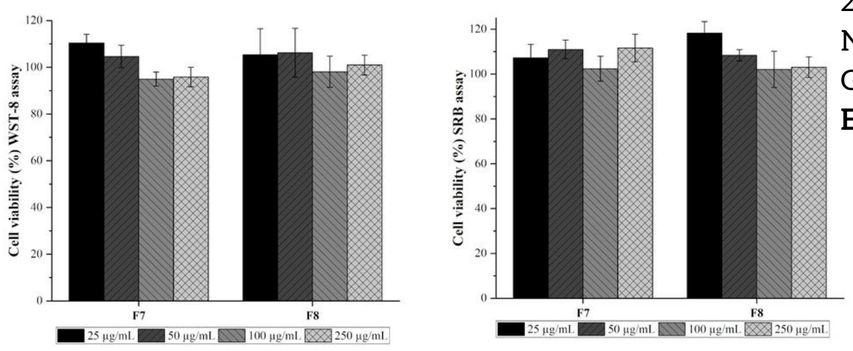


RESULTS

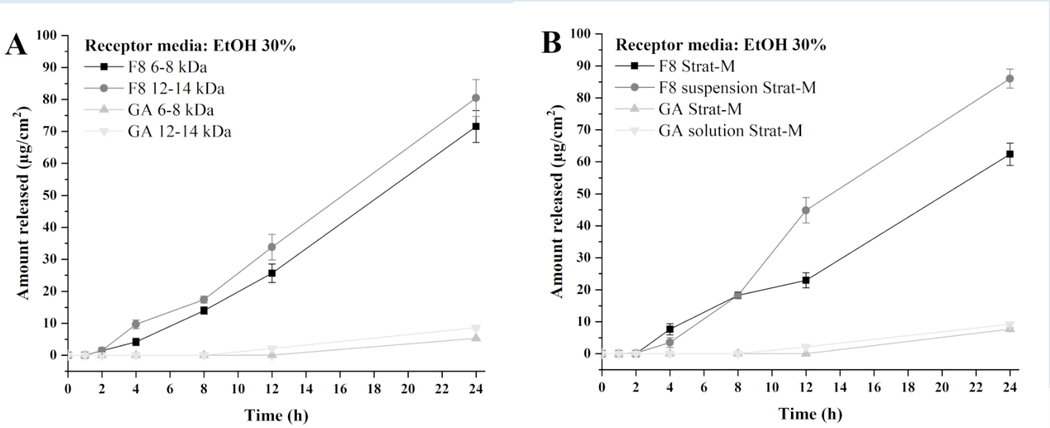


FTIR of GA, plain liposomes and GA-loaded liposomes

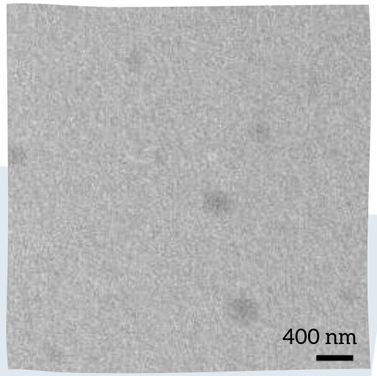
202 ± 5.2 nm
Narrow **size distribution**
Good **stability** over a period of 30 days
Encapsulation efficiency of 63.15 ± 2.2%,

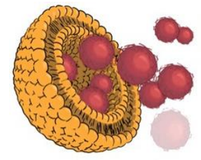


Cell viability of HaCaT cell line after incubation with unloaded liposomes and GA loaded liposomes at different concentrations for 24 h at 37 °C. The viability was determined by WST-8 and SRB assays



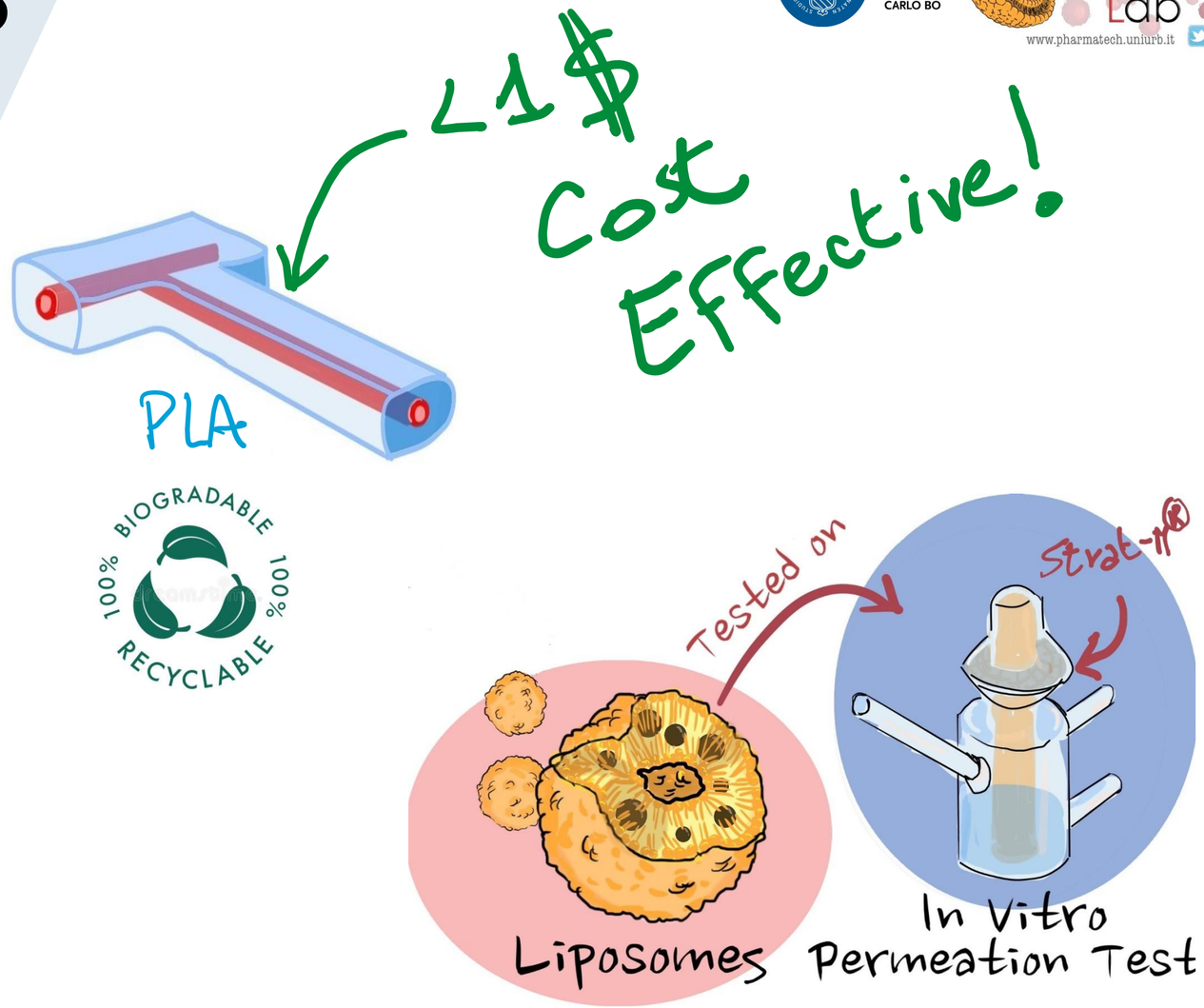
In vitro release and permeation studies using vertical diffusion cells (VDC) with Ethanol 30% (v/v) as receptor medium (A, B). In the graphs, the GA-loaded liposomal hydrogel, the GA-loaded liposomal suspension, saturated GA hydrogel and saturated GA solution.
are represented. Cellulose dialysis membranes with a different cut-off (A) and skin mimicking Strat-M® membranes (B) were used.





CONCLUSIONS

- Development of an ethanolic liposomal formulation encapsulating GA intended for topical administration with good physicochemical characteristics and an EE% of GA up to 63 %,
- Development of a biodegradable and cost-effective PLA 3D-printed microfluidic chip which represents an affordable microfluidic device with an easy fabrication, very low cost (13 g of PLA for a total cost of less than 1 US $) and potential scalability for higher production rates (up to 900 mL/h).
- The liposomal hydrogel compared to GA-saturated hydrogel reached an almost 10x times higher drug release and an 8x times higher drug permeation across skin mimicking Strat-M® membranes that could represent a reproducible methodology using VDC, alternative to ex-vivo skin in diffusion studies.



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Thank you for your attention

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