

Innovative Drug delivery Systems

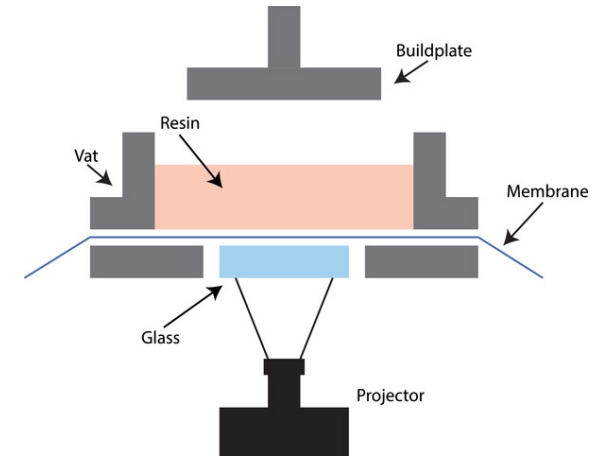
Aristotle University of Thessaloniki, Department of Pharmacy

EPTRI Scientific Meeting– Bari – 19/07/2024

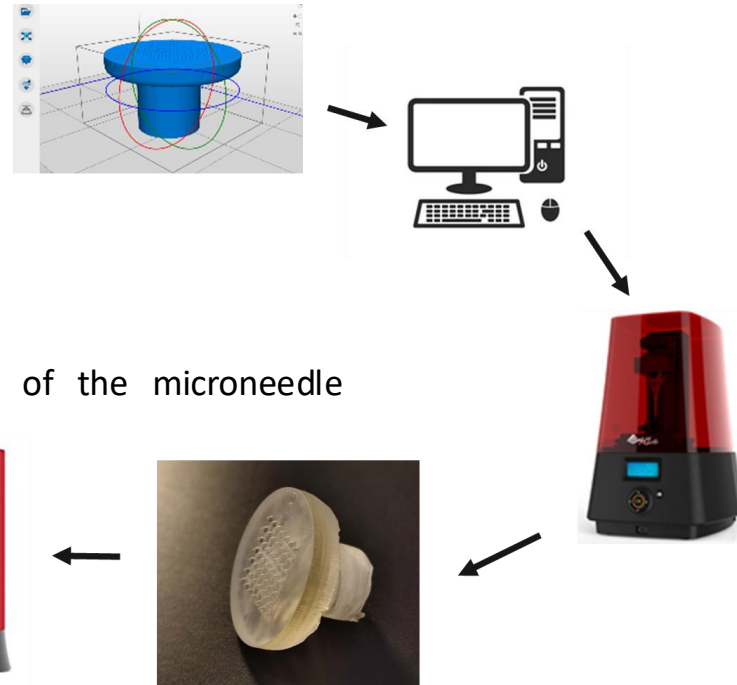
3D printing – DLP printing



- AM technologies may overcome challenges in drug formulation development by addressing the requirement of personalized therapy
- AM allows the creation of formulations in a simple single-step process

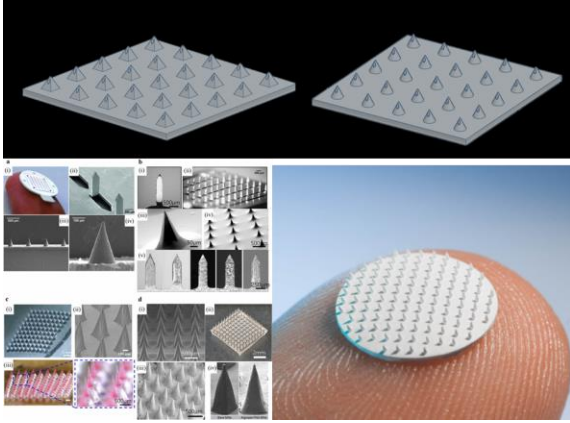


- Digital design of hollow Microneedles
- Loading the stl. file to the DLP printer
- Biocompatible resin for the production of the microneedle devices



- Digital Light Processing (DLP) printing is based on photopolymerization of a liquid resin
- It creates solid objects with high resolution and accuracy.
- The most appropriate 3D printing process for the production of microneedle arrays

Biomedical Devices



The transdermal route offers several advantages

- Fast onset of action (increased blood supply)
- Absence of drug degradation compared to GI tract
- Absence of hepatic first pass metabolism
- Reduced dose and toxicity
- Potential to achieve local or systemic therapeutic effects

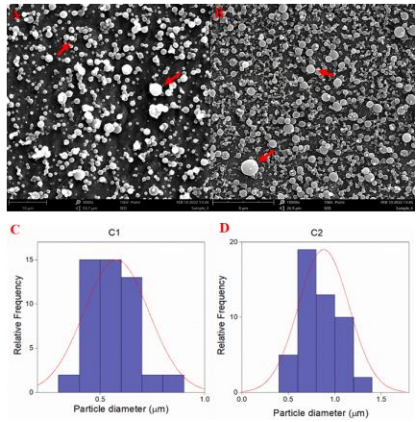
- Drug delivery system for drugs, vaccines and macromolecules
- Micron sized needles for non-invasive administration

Pediatric population

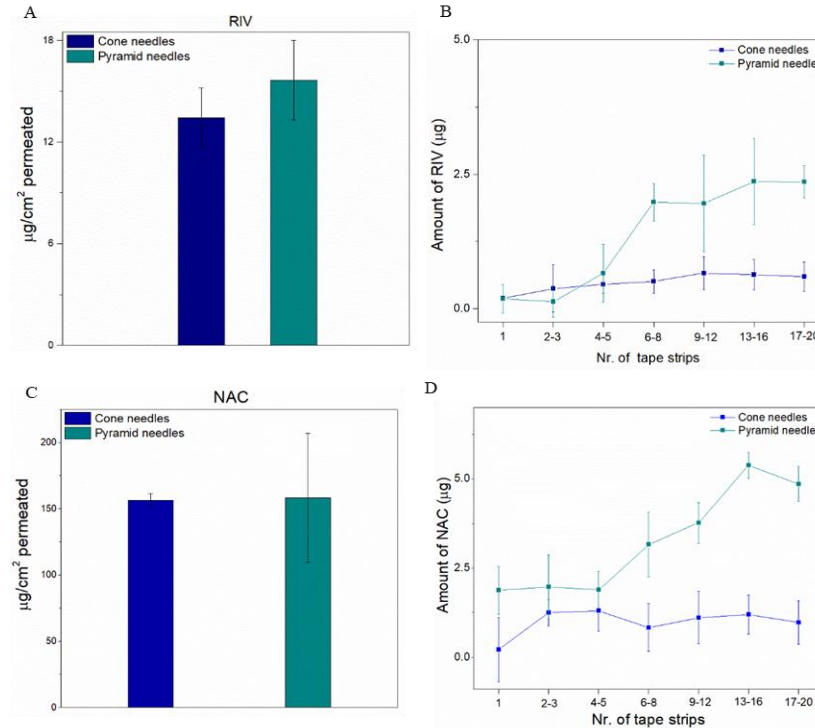
Injections are associated with fear and discomfort, affecting adherence

3D printed coated microneedles for simultaneous delivery of actives

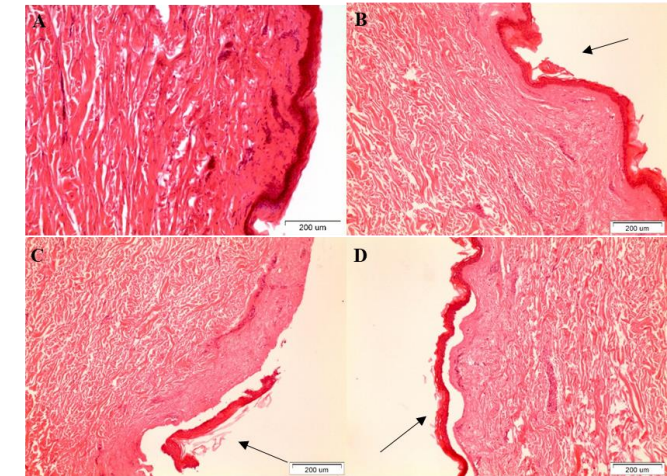
Physicochemical characterization



Permeability studies

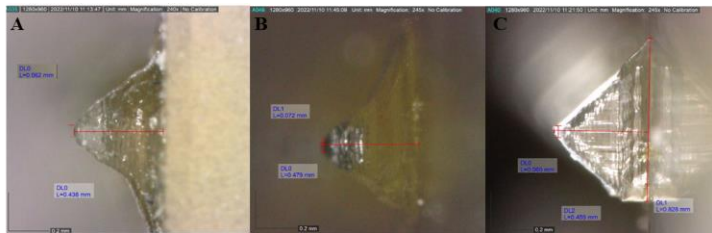


Biocompatibility studies



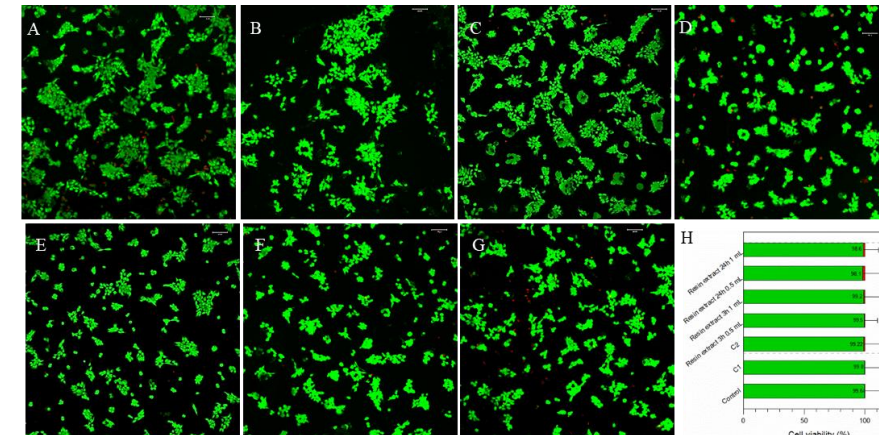
Microscopic appearance of skin tissue **A)** (control) and after piercing with **B)** pyramid-like needles, **C)** cone-like needles and **D)** arrow-like needles.

A) and **B)** SEM images of the electrospayed particles C1 and C2, respectively, **C)** and **D)** histograms of C1 and C2 particles, respectively



Optical microscopy and dimensions of **A)** cone-like needles, **B)** pyramid-like needles and **C)** arrow-like needles

A) $\mu\text{g}/\text{cm}^2$ permeated for RIV, **B)** the amount of RIV detected in stratum corneum after tape stripping, **C)** $\mu\text{g}/\text{cm}^2$ permeated of NAC and **D)** the amount of NAC detected in the stratum corneum.

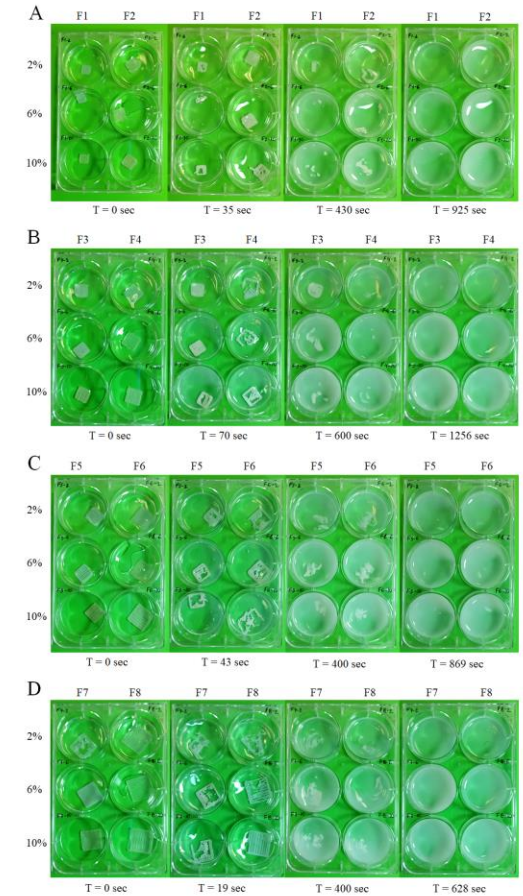
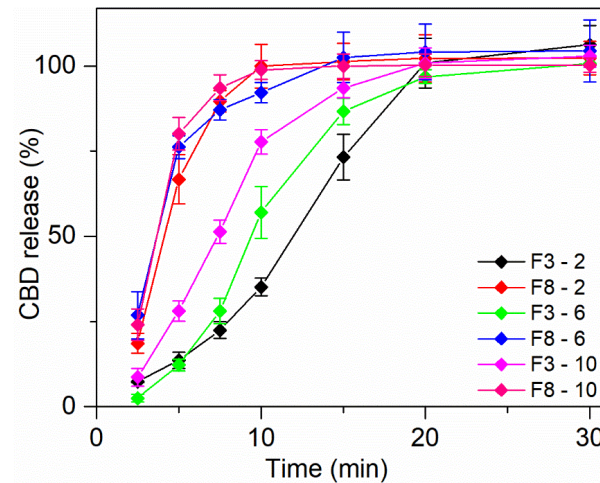
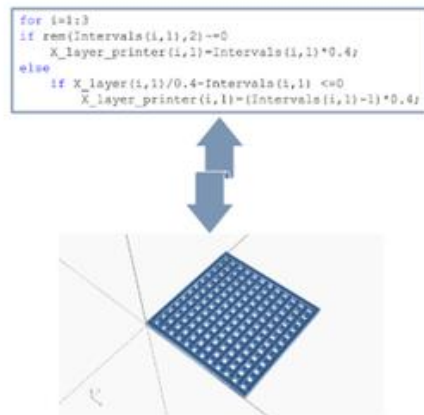
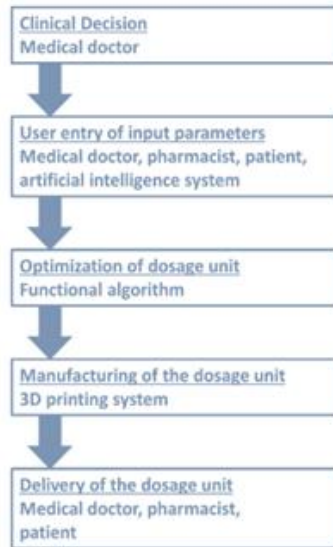
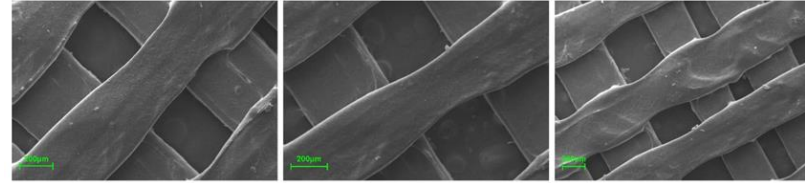


Live/dead assay of HaCaT cells after incubation formulations resin extract and control

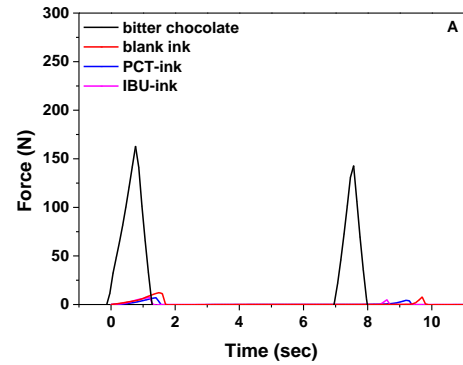
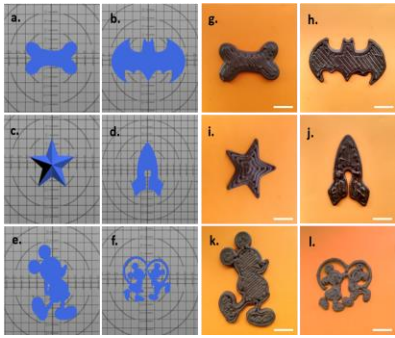
Monou et al. ACS Appl Bio Mater. 2024 7(5):2710-2724

Automated digital design for 3D-printed individualized therapies (3D printed CBD ODFs)

- A proof-of-concept computational algorithm which calculates the optimal dimensions of grid-like orodispersible films (ODFs), considering the recommended dose
- Personalization of the drug product is a potential measure to inhibit CBD abuse, as both the dose and the intended

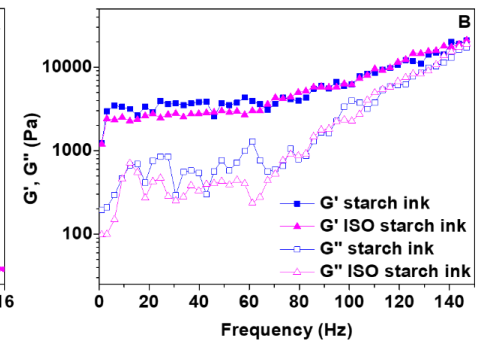
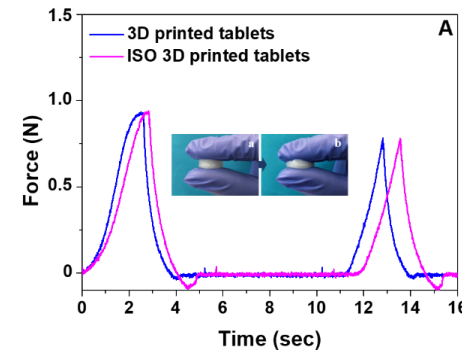
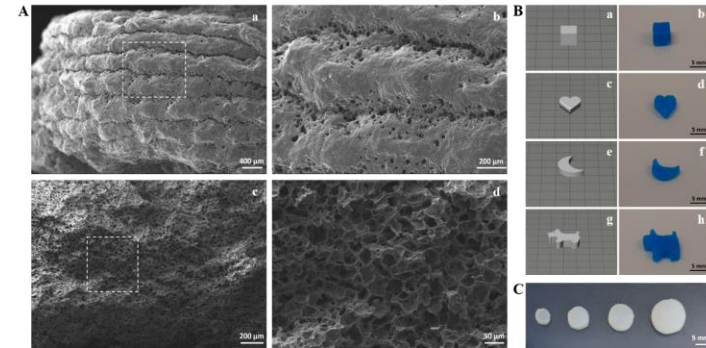
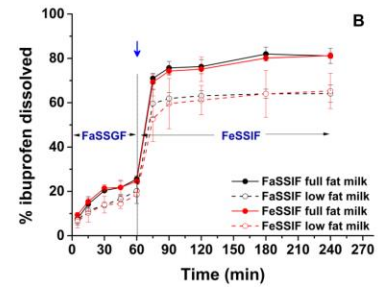
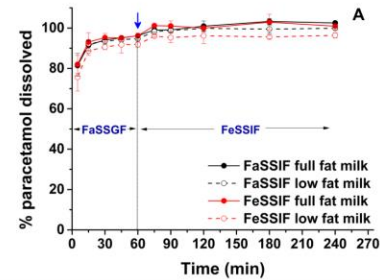
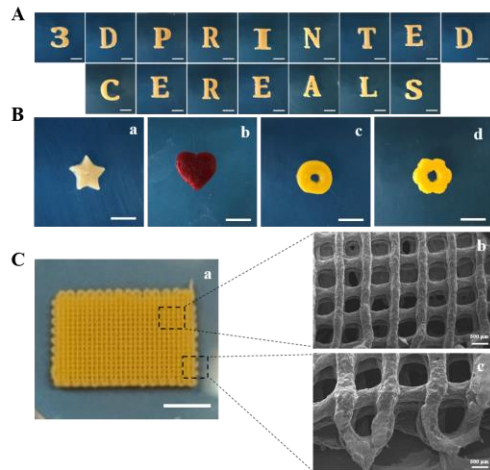


Chewable pediatric friendly formulations



TPA parameters	Formulation			
	Bitter chocolate	Blank ink	IBU-ink	PCT-ink
Hardness (N)	169.86 ± 9.95	12.91 ± 1.76	8.80 ± 1.80	7.85 ± 2.86
Cohesiveness	0.846 ± 0.027	0.315 ± 0.134	0.161 ± 0.020	0.386 ± 0.071
Springiness (mm)	0.777 ± 0.157	1.002 ± 0.004	0.367 ± 0.166	0.980 ± 0.038
Chewiness (N)	111.99 ± 25.43	4.34 ± 2.51	0.547 ± 0.318	2.87 ± 0.71
Adhesiveness (N·mm)	-	4.56 ± 1.90	1.67 ± 0.65	2.80 ± 1.17

Karavasili et al. Eur. J. Pharm. 2020;147:105291



Karavasili et al. J. Pharm. Sci. 2022 111(9):2562-2570

