



## **Distribution and quantitative analyses of poorly water soluble drugs loaded by supercritical CO<sub>2</sub> impregnation in microcontainers with different sizes**

**Mazzoni, Chiara; Tentor, Fabio; Antalaki, Anastasia ; Jacobsen, Rasmus Due; Mortensen, Jacob ; Slipets, Roman; Ilchenko, Oleksii; Keller, Stephan Sylvest; Nielsen, Line Hagner; Boisen, Anja**

*Publication date:*  
2018

*Document Version*  
Peer reviewed version

[Link back to DTU Orbit](#)

*Citation (APA):*

Mazzoni, C., Tentor, F., Antalaki, A., Jacobsen, R. D., Mortensen, J., Slipets, R., ... Boisen, A. (2018). Distribution and quantitative analyses of poorly water soluble drugs loaded by supercritical CO<sub>2</sub> impregnation in microcontainers with different sizes. Abstract from Controlled Release Society Annual Meeting & Exposition 2018, New York, United States.

---

### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

## Distribution and quantitative analyses of poorly water soluble drugs loaded by supercritical CO<sub>2</sub> impregnation in microcontainers with different sizes

Chiara Mazzoni, Fabio Tentor, Anastasia Antalaki, Rasmus Due Jacobsen, Jacob Mortensen, Roman Slipets, Oleksii Ilchenko, Stephan Sylvest Keller, Line Hagner Nielsen, Anja Boisen

*The Danish National Research Foundation and Villum Foundation's Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics (IDUN), Department of Micro- and Nanotechnology, Technical University of Denmark, Ørstedes Plads 345C, 2800 Kgs. Lyngby, Denmark*

Learning objectives:

1. Explain the supercritical CO<sub>2</sub> impregnation as a loading technique for microcontainers
2. Evaluate if the loading process is affected by the surface area exposed to the supercritical CO<sub>2</sub>
3. Discuss if the quantity and distribution are different when loading two different poorly water soluble drugs

**Introduction:** Microcontainers (MCs) are polymeric cylindrical microdevices with only one side open [1]. MCs can be filled with a polymer matrix followed by loading a drug into the polymer-filled MCs using supercritical CO<sub>2</sub> (scCO<sub>2</sub>) impregnation for potential use in oral drug delivery [2].

The aim of this study was to investigate the quantity, distribution and solid state form of the poorly water soluble drugs, ketoprofen and naproxen loaded into three different sizes of polymer-filled MCs using scCO<sub>2</sub>. The different diameters of the MCs provided different surface areas of polymer exposed to the scCO<sub>2</sub> during the drug loading process.

**Methods:** MCs were fabricated in SU-8 (Fig. 1a) using two-steps of photolithography resulting in cylinders with internal diameter of 110 μm (small), 220 μm (medium) and 440 μm (large). MCs were filled manually with polyvinylpyrrolidone (PVP) K10 powder. Polymer-filled MCs were impregnated with ketoprofen or naproxen by means of scCO<sub>2</sub> impregnation (Fig. 1b). Ketoprofen was loaded using 100 bar, 40°C for one hour as scCO<sub>2</sub> impregnation parameters, whereas for naproxen, the parameters were set at 120 bar and 45°C for one hour. The *in vitro* release of ketoprofen and naproxen from the impregnated MCs was analyzed in 10 mM PBS solution at 37°C using a μDISS profiler. For evaluation of the solid state form of the drugs in the MCs for the different sizes, Raman spectroscopy and X-Ray Powder Diffraction were used. Raman maps were acquired using a DXR Raman microscope to analyze the distribution of the drug in the MCs.

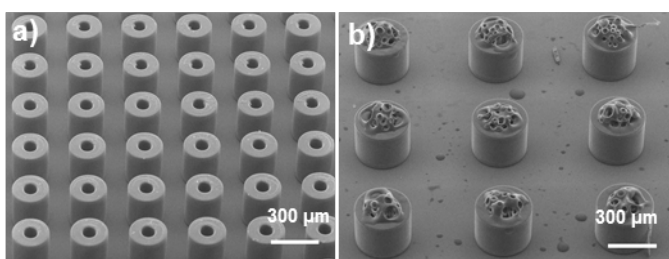
**Results:** The quantity of the drug loaded into the different sizes of MCs and for the two drugs was not found to be statistically different. The release of naproxen or ketoprofen from the MCs showed similar kinetics for the different sizes and for the two drugs, reaching 90 % release within the first 10 min. By the use of Raman microscopy, it was evaluated if the exposed surface area influenced the distribution of the drugs in the MCs. An example with ketoprofen can be seen in Fig. 2, where the distribution of the drug in the uppermost layers inside the MCs was evaluated. Ketoprofen loaded into the MCs was found to be in its amorphous form, whereas naproxen was in a metastable form.

**Conclusions:** MCs having different surface areas exposed to the scCO<sub>2</sub> did not affect the quantity and release kinetics of loaded ketoprofen or naproxen.

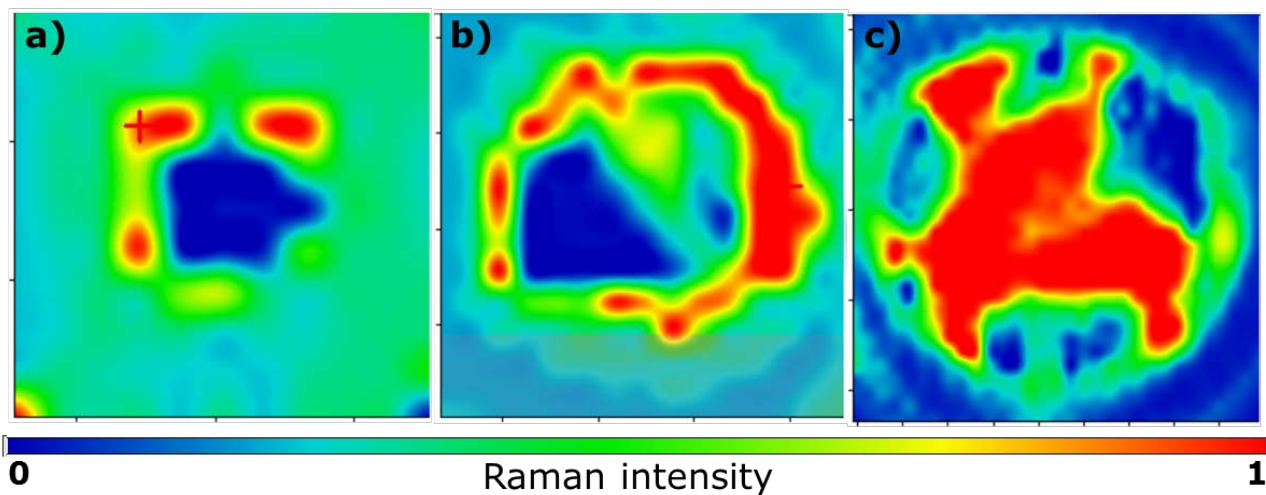
**References:**

- [1] L.H. Nielsen, S.S. Keller, K.C. Gordon, A. Boisen, T. Rades, A. Müllertz, Spatial confinement can lead to increased stability of amorphous indomethacin, *Eur. J. Pharm. Biopharm.* 81 (2012) 418–425. doi:10.1016/j.ejpb.2012.03.017.
- [2] C. Mazzoni, F. Tentor, S.A. Strindberg, L.H. Nielsen, S.S. Keller, T.S. Alstrøm, C. Gundlach, A. Müllertz, P. Marizza, A. Boisen, From concept to in vivo testing: Microcontainers for oral drug delivery, *J. Control. Release.* 268 (2017) 343–351. doi:10.1016/j.jconrel.2017.10.013.

**ACKNOWLEDGEMENTS:** The authors would like to acknowledge the Danish National Research Foundation (DNRF122) and Villum Fonden (Grant No. 9301) for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics (IDUN).



**Fig. 1:** SEM images of a) small empty MCs and b) ketoprofen-loaded medium MCs.



**Fig. 2:** Raman map on peak 1003 cm<sup>-1</sup> representing the distribution of ketoprofen in the uppermost layers inside the of a) small, b) medium and c) large MCs.