Dermal application of nanostructured lipid carriers containing lidocaine

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1 INTRODUCTION

Dermal delivery of lidocaine could offer solution to many adverse effects caused by subcutaneous injections (e.g. pain, local reactions, toxicity). NLCs are modern drug carrier systems offering good stability, low cost, possibility of scale-up and controlled drug delivery. Furthermore, they facilitate the penetration of the incorporated drug and support the physiological conditions of the skin.

2 METHODS

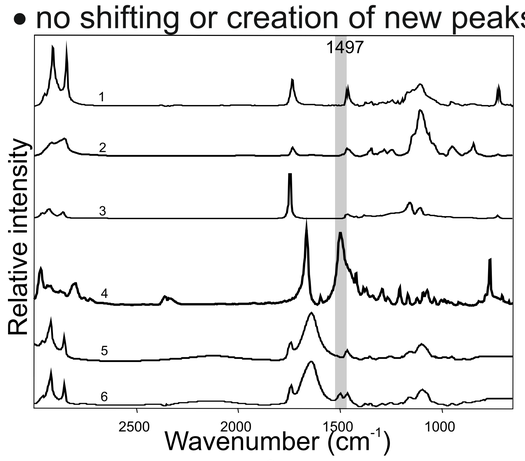
NLC was prepared by ultrasonication method. To characterize the carrier system *in vitro* investigations were performed (particle size, zeta potential measurements, Fourier- transform infrared spectroscopy (FT-IR) and differential scanning calorimetry (DSC). Release and skin penetration was examined by Franz diffusion cell and Raman spectroscopic mapping. The *in vivo* effect of the formulation was followed by measurements on skin hydration and TEWL.

FT-IR, RAMAN

For the determination of **API-excipient interactions** FT-IR () spectroscopy was used.

- all the characteristic peaks are present
- no shifting or creation of new peaks

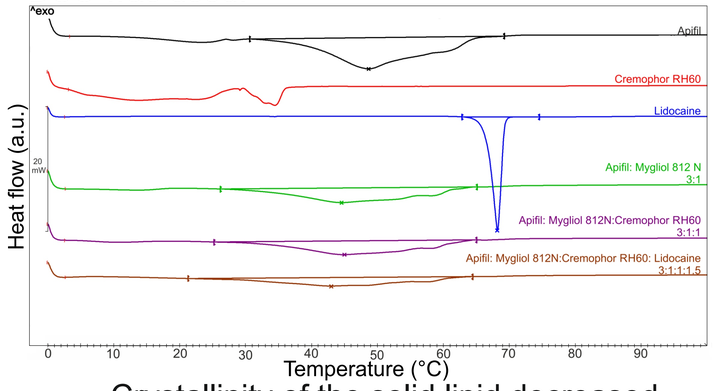
➡ **no chemical interaction**



Notes: Apifil (1), Cremophor® RH60 (2), Mygliol 812 N (3), Lidocaine (4), Lidocaine-free NLC (5), Lidocaine NLC (6)

DSC, XRPD

In order to investigate **lipid crystallization** DSC was used.



Crystallinity of the solid lipid decreased

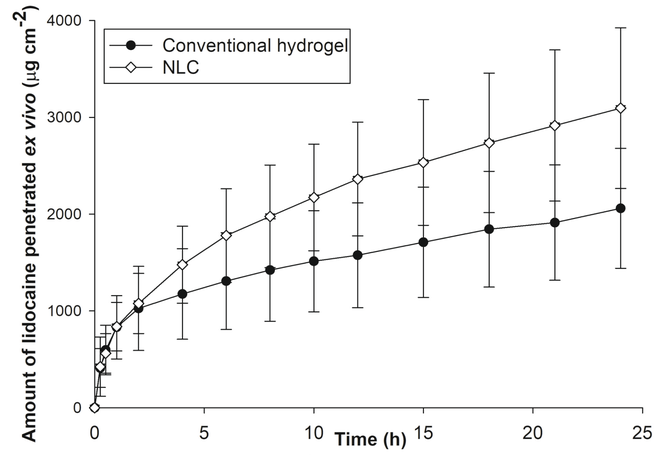
➡ **higher loading capacity** of the lipid matrix

PARTICLE SIZE, ZETA POTENTIAL

Particle size	Polydispersity index	Zeta potential
87.61 ± 0.55 nm	0.1615 ± 0.01	-11.983 ± 0.31 mV

low polydispersity index ➡ **good stability**

SKIN PENETRATION



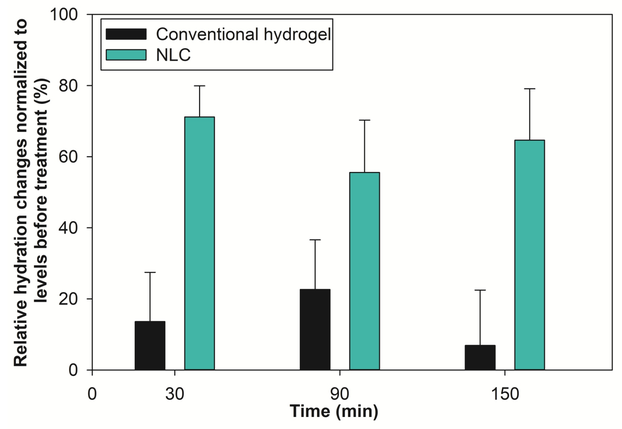
special structure ➡ high bioavailability
components have good miscibility with skin lipids

➡ **higher penetration** *ex vivo* compared to the conventional hydrogel

3 RESULTS

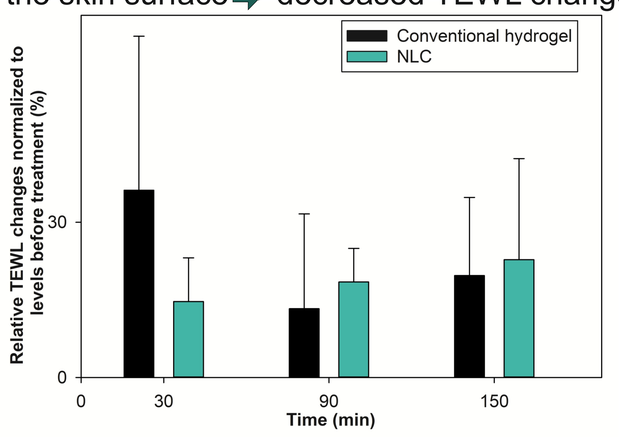
SKIN HYDRATION

- **remarkable increase in skin hydration** after 30 min
- maintained at high level after 150 minutes



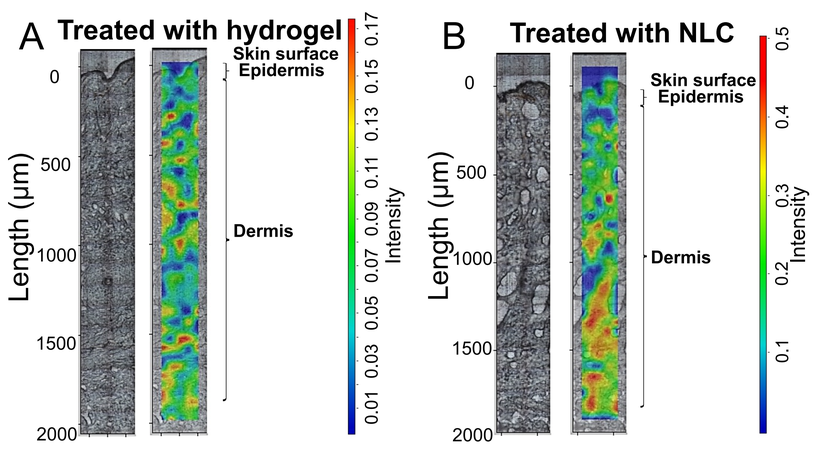
TEWL

NLC caused **slight increase in TEWL** compared to conventional hydrogel.
Particle size< 200 nm ➡ lipid film forming on the skin surface ➡ decreased TEWL changes



RAMAN MAPPING

Lidocaine is **present** also **in the epidermal and dermal layers** of skin in **high concentration**.



4 CONCLUSION

Our results confirmed that the developed lidocaine-NLC is a promising vehicle for topical local anesthesia: it has considerable penetration properties, skin hydrating and occlusive effect, which makes it a favorable dermal carrier system.

Overview

Effective topical local anesthesia is a challenge nowadays, because most of the marketed formulations have moderate skin penetration properties, rapid but short effect. Therefore, innovative dermal formulations are needed to overcome the barrier function of the skin and provide sufficient and prolonged local anesthesia. We developed and investigated a lidocaine-containing nanostructured lipid carrier (NLC) system. Our *in vitro, ex vivo* and *in vivo* investigations confirmed that this formulation is a promising vehicle for effective topical local anesthesia.

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