Microneedle/nanoencapsulation enhanced skin permeation of model dyes: Effect of nanocarrier characteristics

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Introduction: A dual microneedles (MN) /PLGA nanoparticles (NPs) approach was reported earlier to result in marked enhancement in skin permeation of rhodamine B (Rh B) dye through full thickness pig skin [1]. The objective of this study was to gain more insight into the enhancement mechanism by investigating the effect of PLGA NPs characteristics on skin permeation of two dyes with different skin permeability, rhodamine B (Rh B) and Fluorescein isothiocyanate (FITC) [2].

Methods: The effect of PLGA NPs size and charge, PLGA co-polymer ratio (100:0, 75:25, 50:50) and % loading on the *in vitro* permeation of both dyes through MN-treated (600 µm length and 121 MNs/array) full thickness pig skin was investigated. Fabrication of Gantrez® AN-139 MNs involved the use of laser-engineered silicon micromould templates[1]. NPs were prepared using an emulsion-diffusion-evaporation technique. Permeation experiments were followed by confocal laser scanning microscopy (CLSM) to track dye permeation.

Results:

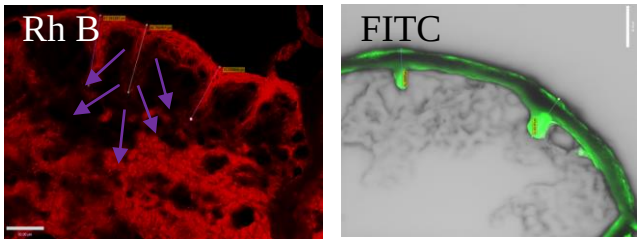

Fig.1: CLSM images of pig skin following MN-mediated skin permeation of Rh B and FITC PLGA NPs

MN-mediated skin permeation of dye-loaded in PLGA NPs was enhanced by reduction in NPs size, negative charge on NPs, lower lactic acid content of PLGA copolymer, higher dye solubility and greater dye loading (in case of Rh B). CLSM imaging (Fig 1) revealed accumulation of NPs of both dyes in MN-created microconduits with release and diffusion of Rh B through deeper skin layers and confinement of FITC NPs to the microconduits which was consistent with skin permeation data. Findings are of importance in the formulation of NPs for MN-mediated skin permeation of drugs for dermal and transdermal delivery.

[1] Gomaa YA, El-Khordagui LK, Morrow DIJ, Garland MJ, Donnelly RF, Kumar MNVR and Meidan VM. Skin Forum, Edinburgh, 6-7 July 2010.

[2] Gomaa YA, El-Khordagui LK, Garland MJ, Donnelly RF, McInnes F and Wilson CG. Skin Forum, Frankfurt, 28-29 March 2011.