Microneedle-enhanced skin permeation of model dyes: Effect of the dye characteristics

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Introduction: Microneedle arrays (MN) have been extensively investigated as a new technology permitting skin penetration of a wide variety of small drugs and macromolecules [1]. The mechanism of MN-mediated permeation enhancement has not been fully elucidated. Our aim was to assess the influence of the permeant physicochemical properties on MN-assisted skin permeation using a series of five structurally-related fluorescent dyes.

Methods: Dyes selected for the study were: Rhodamine B (Rh B, MW 479), Rhodamine B isothiocyanate (RITC, MW 536.1), Rhodamine B isothiocyanate dextran (RITC-D, MW 4.4 kDa), Tetramethyl-rhodamine B isothiocyanate dextran (TRITC-D, MW 10 kDa) and Fluorescein isothiocyanate (FITC, MW 389.4 Da). The effect of molecular weight, aqueous solubility and distribution/partition coefficients between n-octanol or skin and PBS [2] on permeation of dyes through full thickness pig skin pretreated with MN array (600 µm length and 121 MNs/array) was studied. For Rh B, both solid and dissolving MNs containing Rh B were tested.

Results: Skin permeation of the test dyes was negligible except for Rh B and FITC. MN-pretreatment enhanced skin permeation of both dyes only, and the flux being higher in case of Rh B (1.870 *vs* 0.187 µg/cm^2/h for FITC). However, the use of dissolving MN reduced Rh B flux. Findings indicated that all physicochemical characteristics studied are important determinants of the solid MN-assisted skin permeation of the dyes as in the Potts and Guy model [3].

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[3] Potts RO and Guy RH. (1992). Pharm. Res. 9, 663-669.