Biofunctional textile for skin drug delivery by nanoparticles finishing. A comparison among hydrophilic and hydrophobic drugs.

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In the recent years the approach of using skin as route for drug administration has aroused significant interest being a simple and not invasive method. In order to effectively deliver the active substances across the skin the drugs are often encapsulated inside nanocarriers in order to enhance and control their release. Biofunctional textiles are a novel class of materials obtained by finishing textile fabrics with pharmaceutical carriers. Such approach allows the posology to be supported on a not allergenic substrate while creating a simple and wearable drug delivery platform. However, comprehension about how immobilization on the textile substrate would affect the carrier skin permeation upon loading different drugs is still not complete. In the present work, PCL nanoparticles loaded with caffeine and curcumin were applied on cotton fabrics to produce biofunctional textiles. These two drugs were chosen as models for hydrophilic and hydrophobic substances respectively. The PCL nanoparticles were produced as liquid suspension and applied on the fabrics by a cold impregnation method followed by a fast rinsing. The effectiveness of the treatment was investigated in Fourier transform infrared spectroscopy (FTIR) and weight add on measurement. Furthermore, replicability of the finishing treatment was assessed by colorimetric analysis. The treated fabrics were observed by scanning electron microscopy in order to investigate the distribution of the particles onto the fabrics at microscopic level. Ultraviolet spectroscopy was applied in transmission mode on the fabrics in order to evaluate the UV protection factor (UPF). The drug release properties of the particles suspensions and of the treated fabrics were evaluated by a Franz diffusion cell experiment using porcine skin as membrane. FTIR analysis confirmed the presence of the drug loaded nanoparticles onto the textiles highlighting also their interactions by non chemical bonds. Weight add on measurement allowed to quantify the amount of attached particles as 2-3% respect to the cotton weight. Color measurement proved that the similar amounts of curcumin were found over 20 independently treated samples proving the good replicability of the finishing treatment. SEM analysis evidenced how the morphology of the treated fabric changes depending on the colloidal stability of the finishing suspension. Indeed, the highly stable curcumin formulation allowed for a uniform distribution of the particles over the textile surface. Oppositely, the less stable caffeine suspension caused the particles to aggregate in cluster on cotton fibers. The Franz Cell experiment evidenced how the immobilization of the particles on the textile substrate does not alter the release kinetics while increasing the time elution. Caffeine was found to be more easily released in the blood mimicking solution while curcumin tended to accumulate in the lipophilic skin layers.