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Interaction of Nanoparticles with Skin: Accumulation on Skin Surface and Drug Delivery or Translocation and Cellular Uptake

Fiorenza Rancan (1), Sabrina Hadam (1), Sarah Amselgruber (1),Zahra Afraz (1), Qi Gao (2), Christina Graf (2), Bertrand Bellier (3), Jurgen Lademann (4), Bernard Verrier (5), Eckhart Ruehl (2), Ulrike Blume-Peytavi (1), Annika Vogt (1)

1: Clinical Research Center for Hair and Skin Science, Department of Dermatology and Allergy, Charité-Universitaetsmedizin Berlin, Germany
2: Physikalische Chemie, Institut für Chemie und Biochemie Freie Universität Berlin, Takustr. 3, 14195 Berlin, Germany
3: INSERM, UMR_S959, I3, F-75013, Paris, France
4: Center of Experimental and Applied Cutaneous Physiology, Department of Dermatology and Allergy, Charité-Universitaetsmedizin Berlin, Germany
5: Institut de Biologie et Chimie des Protéines, UMR 5086 CNRS/UCBL, 7 Passage du Vercors, 69367 Lyon Cedex 07, France

Particulate carrier systems have been developed and are under investigation for skin and transdermal drug delivery. In order to obtain the desired drug release properties, investigations on particle-skin interactions should include the effects of particles on skin physiology and cell viability as well as the effect of skin on particle integrity, colloidal stability, drug delivery. Upon application of nanoparticles on skin surface, topically applied particles come in contact with stratum corneum, sweat glands and hair follicle canals which have a hydrophobic environment, and a number of lipids and proteins which might interact with the particles and influence their drug release properties. On the other hand, translocation of particles through the skin barrier might also take place along with uptake by different cell populations in the skin, e.g. keratinocytes, antigen-presenting cells. Using human skin explants models, we found a bright spectrum of particle-skin interactions depending on particle size, composition, rigidity, and coating. Rigid inorganic particles, like gold particles with silica shell with size of 160nm, accumulated in skin furrows and hair follicle canals without translocation to the viable epidermis. On the contrary, 200nm solid polystyrene nanoparticles translocated through the skin barrier and were found in association with skin immune system cells. Soft poly-lactic acid (PLA) particles, lost their supramolecular organization and released the incorporated fluorescence dyes in a time-dependent manner upon application on skin surface. PLA particles coated with the HIV-1 p24 peptide were found to release the adsorbed peptide only after their penetration in the hydrophobic environment of the hair follicle canal. The released peptide translocated into the epidermis and was found in association with keratinocytes and dendritic cells. On the contrary, biological virus-like particles carrying the same HIV-1 p24 peptide were found to be associated

prevalently with CD1a-positive Langerhans cells after transcutaneous application on skin explants. These findings show that nanoparticles are attractive drug delivery systems for dermatology and that a variety of drug release features can be achieved by tuning the physico-chemical properties of the nanoparticles in accordance to the skin environment.