Design and engineering of "green" nanoemulsions for enhanced topical delivery of bakuchiol achieved in a sustainable manner : a novel eco-friendly approach to bioretinol.

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Streszczenie

In the present work, we establish novel “environmentally-friendly” oil-in-water nanoemulsions to enhance the transdermal delivery of bakuchiol, the so-called “bioretinol” obtained from powdered Psoralea corylifolia seeds via a sustainable process, i.e., using a supercritical fluid extraction approach with pure carbon dioxide (SC-CO_2). According to Green Chemistry principles, five novel formulations were stabilized by “green” hybrid ionic surfactants such as coco-betaine—surfactin molecules obtained from coconut and fermented rapeseed meal. Preliminary optimization studies involving three dispersion stability tests, i.e., centrifugation, heating, and cooling cycles, indicated the most promising candidates for further physicochemical analysis. Finally, nanoemulsion colloidal characterization provided by scattering (dynamic and electrophoretic light scattering as well as backscattering), microscopic (transmission electron and confocal laser scanning microscopy), and spectroscopic (UV–Vis spectroscopy) methods revealed the most stable nanocarrier for transdermal biological investigation. In vitro, topical experiments provided on human skin cell line HaCaT keratinocytes and normal dermal NHDF fibroblasts indicated high cell viability upon treatment of the tested formulation with a final 0.02–0.2 mg/mL bakuchiol concentration. This excellent biocompatibility was confirmed by ex vivo and in vivo tests on animal and human skin tissue. The improved permeability and antiaging potential of the bakuchiol-encapsulated rich extract were observed, indicating that the obtained ecological nanoemulsions are competitive with commercial retinol formulations.

Słowa kluczowe

local delivery, nanoformulations, nanomedicine, supercritical CO2 extraction, surfactin, coco-betaine, biosurfacants skin application, HaCaT cell line, NHDF cell line

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