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Microalgal-derived Extracellular Vesicles for Next-generation Pharmaceutical and Cosmetic Applications

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Extracellular vesicles (EVs) have garnered significant attention as bio-nanocarriers for the targeted delivery of bioactive compounds. Our research group has developed an innovative platform for the sustainable, scalable, and cost-effective production, engineering, and quality controls of a novel class of EVs derived from microalgae, termed nanoalgosomes. Our previous studies provided a comprehensive characterization of the biochemical and biophysical properties of nanoalgosomes, demonstrating their biocompatibility and efficient cellular uptake in vitro and in vivo models, including mouse model in which biodistribution studies revealed bone-specific tropism. Here, we investigate their intrinsic bioactivity on skin models for cosmetic applications and their potential use as drug nanocarriers on spheroids as cancer model. We first examined their properties, including antioxidant, photoprotective, and antimelanogenic potential. Additionally, we engineered nanoalgosomes through exogenous loading with drugs (e.g., doxorubicin) and nucleic acids (e.g., siRNAs), evaluating both loading efficiency and their functional activity. These studies underscore the effectiveness of nanoalgosomes as a natural and innovative EV-based drug delivery system, highlighting their potential as promising candidates for cell-free therapies and cosmetic applications.