Scientific Letters

Oral Communication 4

Optimized Liposomal Delivery of *Actinidia arguta* Antioxidants for Topical Skin Applications

Filipa Teixeira [1,2], Marta Oliveira [1], Maria de la Luz Cádiz-Guerra [3], Francisco Javier Leyva-Jiménez [3] and Francisca Rodrigues [4,5,*]

[1] REQUIMTE/LAQV, ISEP, Polytechnic of Porto, Rua Dr. António Bernardino de Almeida, 4249-015 Porto, Portugal
[2] ICBAS, University of Porto, Rua de Jorge de Viterbo Ferreira 228, 4050-313 Porto, Portugal
[3] Department of Analytical Chemistry, University of Granada, Fuentenueva s/n, E-18071 Granada, Spain
[4] i4HB, Faculty of Pharmacy, University of Porto, Rua de Jorge de Viterbo Ferreira 228, 4050-313 Porto, Portugal
[5] UCIBIO, MedTech-Laboratory of Pharmaceutical Technology, Faculty of Pharmacy, University of Porto, Rua de Jorge de Viterbo Ferreira 228, 4050-313 Porto, Portugal

* Correspondence: frodrigues@ff.up.pt

Abstract

Background: Natural bioactive compounds offer therapeutic and cosmetic benefits but are often limited by low stability and poor skin penetration. Liposomal nanocarriers represent a promising strategy to overcome these barriers [1]. **Objective:** Optimize liposomes encapsulating an extract from *Actinidia arguta* fruit for topical use, with potential relevance in antitumor skin therapies. **Methods:** The extract was obtained by ultrasound-assisted extraction [2] and incorporated into phospholipid liposomes via probe sonication [3]. A central composite design was applied to optimize lecithin, extract concentration, and sonication amplitude, targeting minimal vesicle size (VS) and polydispersity index (PDI), and maximal encapsulation efficiency (EE). The optimized liposomes were characterized regarding phytochemical composition (LC-DAD-MS), structural integrity (TEM, FTIR, DSC) and stability. Biocompatibility was investigated by measuring cell viability of HDFa, HaCaT, and A375 cells after 24 h of exposure using the MTT assay. **Results:** The optimized liposomes consisted of 167.9 mg/mL lecithin, 42.5 mg/mL extract, and 28% amplitude (R^2 = 0.995), yielding nanosized vesicles (107.2±2.2 nm) with uniform distribution (PDI of 0.173±0.011), a strongly negative zeta potential (ZP; −47.8±1.6 mV), and an EE of 50.7±2.5%. LC-DAD-MS confirmed the presence of chlorogenic and neochlorogenic acids, catechin, kaempferol, quercetin, and sugar derivatives. Over 90 days, liposomes remained stable (VS<150 nm; PDI<0.2; ZP −50 mV). TEM, FTIR and DSC (Figure 1A,B,C) indicated preserved lipid structure and extract integrity, with evident interactions between the bioactives and phospholipids. Biocompatibility studies (Figure 1D) showed >70% viability in keratinocytes and fibroblasts, with mild stimulation at low doses. A375 melanoma cells exhibited slight, dose-dependent reductions in viability only at high concentrations, suggesting nonspecific metabolic effects related to the lipid vesicles or the sugars present on the extract. **Conclusions:** The optimized liposomal system efficiently encapsulates *A. arguta* fruit antioxidants, while maintaining stability and safety, supporting its suitability for topical delivery and further evaluation in melanoma models.

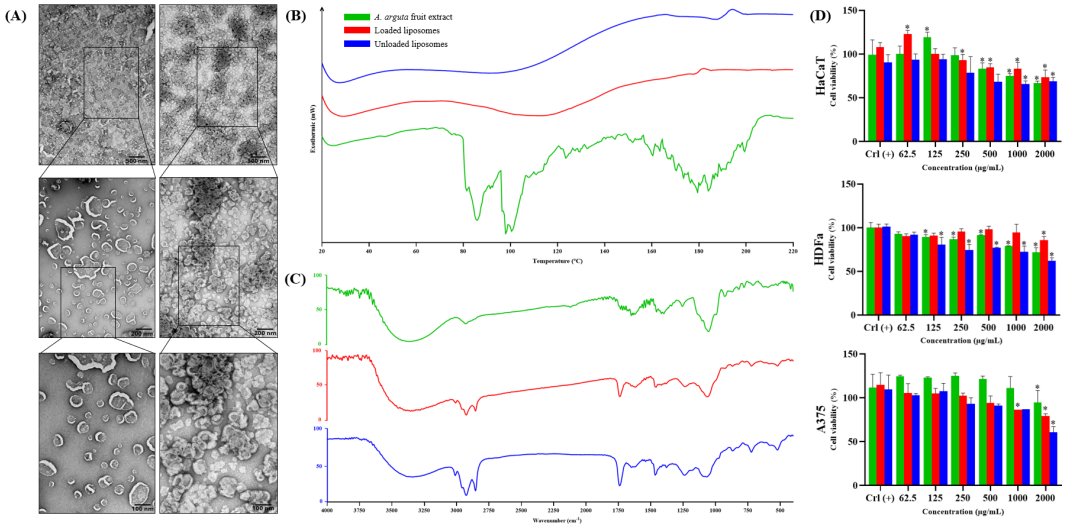

Figure 1. Characterization of optimized liposomes: (A) TEM images of loaded (left) and unloaded liposomes (right), (B) DSC thermograms, (C) FTIR spectra and (D) HaCaT, HDFa and A375 cell viability after 24h of exposure ($n = 3$); *$p < 0.05$.

Keywords: liposomes; *Actinidia arguta* fruit; topical application

Acknowledgments/Funding

This work was supported by FCT/MCTES (Portugal) through: FireSkin (2024.07134.CBM), UID/50006, UID/04378/2025, UID/PRR/04378/2025, LA/P/0140/2020, and individual grants (2024.01202.BD, 02/C06-i06/2024, 2023.14718.TENURE.016).

References

1. Yang, S. et al. Encapsulating plant ingredients for dermocosmetic application: an updated review of delivery systems and characterization techniques. *Int J Cosmet Sci* **2020**, *42*, 16-28, doi:10.1111/ics.12592
2. Macedo, C. et al. Insights into the polyphenols extraction from *Actinidia arguta* fruit (kiwiberry): A source of pro-healthy compounds. *Sci Hortic* **2023**, *313*, 111910, doi:10.1016/j.scienta.2023.111910
3. Villegas-Aguilar, MdC. et al. Targeted breast cancer therapy using novel nanovesicle formulations of *Olea europaea* extract. *Biomed Pharmacother* **2024**, *180*, 117583, doi:10.1016/j.biopha.2024.117583