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Low-energy nanoemulsions for curcumin delivery: investigation of the interfacial phenomena in the colloidal system and peculiarities important for biological performances

Ines Nikolić, Snežana Savić

Department of Pharmaceutical Technology and Cosmetology, University of Belgrade - Faculty of Pharmacy, Belgrade, Serbia

Low-energy nanoemulsions (LE-NEs) represent novel and multifunctional drug carriers [1]. Curcumin, a powerful pleiotropic molecule, was used as a model active ingredient in this study. However, due to physicochemical instability, poor solubility and low targeting efficacy, its potentials are still beyond the reach [2]. Therefore, the aim was to investigate developed LE-NEs as promising vehicles for curcumin delivery, linking microstructural properties of the carrier to delivery and biological performance.

After structural investigation, applying several physicochemical techniques (photon correlation spectroscopy, differential scanning calorimetry, atomic force microscopy, electron paramagnetic resonance spectroscopy), efficacy of curcumin and curcumin-loaded LE-NEs was assessed in terms of antioxidant activity and in biological assays with several cell lines (Fem-X, HeLa, MRC-5).

All developed formulations had mean droplet diameter below 150nm, with narrow distribution. It was demonstrated that curcumin interacts with the interfacial region of the LE-NE, being a part of the surfactant layer, closer to the lipophilic region. Scavenging activity of curcumin-loaded LE-NEs was high, remaining unaltered after several months of storage. Encapsulation in the LE-NE enhanced its safety profile, providing significant cytotoxicity towards HeLa and Fem-X compared to the effect towards MRC-5 (IC50=22.89±2.09; 37.87±7.09 and 67.72±0.4μg/ml, respectively). After the cell cycle analysis, it was proved that the cycle arrest of the cancer cells mostly happened in the subG1 and G2/M phase, underlining the ability of curcumin to interact with numerous cellular signaling pathways.

References

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Supervisor: prof. Snežana Savić