Soluplus® Micellar Systems as Nanocarriers for Leishmaniasis Therapy

Nerea Guembe-Michel [a], Steven Parnell [b], Paul Nguewa [c], Gustavo González-Gaitano [a]

[a] Department of Chemistry, School of Science, University of Navarra, 31008, Pamplona, Spain.
[b] ISIS Neutron Muon Source, Science and Technology Facilities Council, Rutherford Appleton Laboratory, Didcot OX11 0QX, UK.
[c] Department of Microbiology and Parasitology, Navarra Institute for Health Research (IdisNA), University of Navarra, 31008, Pamplona, Spain.

nguembe.1@alumni.unav.es

The development of advanced colloidal carriers for localized treatment of Cutaneous Leishmaniasis (CL) offers a superior alternative to conventional systemic therapies, which are often limited by toxicity and drug solubility. This study explores the development of a tunable colloidal platform based on Soluplus® (SLP), an amphiphilic triblock copolymer, focusing on the fundamental interactions that drive drug encapsulation and biological efficacy. Using Dynamic Light Scattering (DLS), Nuclear Magnetic Resonance (NMR), and Small-Angle Neutron Scattering (SANS), we analyzed the structural transitions from the pristine polymer to binary and ternary systems. We found that drug partitioning is strictly dependent on the component ratios: while PTM consistently interacts with the hydrophilic PEG shell, the role of MF is adaptive. In MF-dominant regimes, SLP acts as an interfacial stabilizer for MF-rich micelles. Conversely, in SLP-dominant systems, MF is incorporated into the micellar shell. The ternary system (SLP/PTM/MF) exhibits a complex colloidal hierarchy influenced by temperature: the system reorganizes into stable SLP micelles with MF:PTM complexes in the shell , coexisting with highly dispersed drug-polymer complexes. *In vitro* biological assays demonstrated that binary (SLP-drug) and ternary (SLP/PTM/MF) systems maintain potent antileishmanial activity against *Leishmania major* promastigotes and intracellular amastigotes, and reduce cytotoxicity in macrophages compared to pure drugs. The ternary system reveals a significant therapeutic synergy, enhancing antiparasitic action. Overall, these results highlight the potential of SLP-based colloidal formulations to provide a safer and more efficient localized treatment for cutaneous infections.

Keywords:
Soluplus, Leishmaniasis, Pentamidine, Miltefosine, DLS, NMR, SANS

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