Structural characterization by scattering and spectroscopic methods of mixed micelles of Pluronic F127 and miltefosine

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Poloxamers, commonly known as Pluronic ®, are amphiphilic linear block copolymers that self-assemble into micelles in aqueous solutions. Due to their biocompatibility and physicochemical properties, they are widely used in pharmacy for drug delivery applications. Herein, we investigate the properties of Pluronic F127 as a nanocarrier for Miltefosine (MF), an amphiphilic, alkylphospholipid used as an antiparasitic drug. A full structural characterization of the aggregates has been carried out at physiological pH, using small-angle neutron scattering (SANS) and dynamic light scattering (DLS), combined with proton 1D and 2D nuclear magnetic resonance (NMR) spectroscopy, to determine the precise location of the drug. DLS results indicate the co-assembly of both surfactants into mixed micelles, which remain stable over a wide range of temperatures and exhibit a single size distribution with an intermediate hydrodynamic radius compared to the individual surfactants. NMR results indicate that both the hydrophobic and hydrophilic domains of the drug interact primarily with the hydrophobic PPO core of the F127 micelles, suggesting that the MF is preferentially localized within the micelle core. The structural properties of the aggregates depend on the proportions of drug and carrier. When MF is in excess, SANS shows that the structure of the mixed micelles resemble MF ones, characterized by their reduced size, a dehydrated core, and a lower F127 aggregation number, whereas they become similar to pure F127 micelles as the concentration of the poloxamer increases. Overall, this work demonstrates that F127–MF mixed micelles provide a versatile and tunable colloidal system by an adequate control of composition and temperature, with potential applications for the treatment of parasitic pathologies.

Keywords:
Polymeric micelles, Pluronic, miltefosine, SANS

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