

Studies on the amphiphilic block copolymer Soluplus® behaviour forming micelles to enhance drug solubility

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In the context of studying encapsulation systems using biocompatible polymers, the behaviour of Soluplus®, an amphiphilic block copolymer, has been explored. In aqueous solution, it undergoes self-assembly to form micelles, enabling the solubilization of molecules across a wide range of hydrophobicity. This is facilitated by the presence of vinyl caprolactam (a relatively hydrophilic monomer) in Soluplus's graft chain, which also enhances its interaction with more hydrophilic molecules. To better understand the micellar behaviour of this polymer, Soluplus aqueous solutions at a wide range of polymer concentrations (0.01 g/mL – 0.3 g/mL) were analysed using diffusion NMR (dNMR), small-angle X-ray scattering (SAXS), static (SLS) and dynamic light scattering (DLS), and viscosity measurements. These techniques were complemented by surface tension measurements to determine the polymer's critical micellar concentration (CMC). dNMR, SAXS, DLS, and SLS indicate that, at all tested concentrations, two forms of Soluplus micelles were detected, with hydrodynamic radii of 3 nm and 26 nm [1].

The large micelles are spherical in shape with a core-shell structure while the small objects are less ordered but, at room temperature, accounts for 60–70 %wt of the total. SLS at variable temperature (T) demonstrate that the increase in T shifts the equilibrium towards the large spherical micelles. Interestingly, the formation of large particles occurs three orders of magnitude above the CMC determined from surface tension measurements. Instead of the traditional cooperative micellization process, we propose a thermally activated isodesmic self-assembly of the small aggregates into core-shell micelles.

As next step, the aim is to investigate the application of these micelles as a drug delivery system. Preliminary results on the use of Soluplus® micelles to encapsulate the anti-cancer drug doxorubicin will be also presented.

Keywords:

diffusion-NMR, static light scattering, amphiphilic block copolymer

References:

[1] H. Mateos; L. Gentile; S. Murgia; G. Colafemmina; M. Collu; J. Smets; G. Palazzo, Understanding the self-assembly of the polymeric drug solubilizer Soluplus®, J. Colloid Interface Sci., 611 (2022) 224-234