World Academy of Science, Engineering and Technology
International Journal of Biotechnology and Bioengineering
Vol:13, No:06, 2019

Micelles Made of Pseudo-Proteins for Solubilization of Hydrophobic Biologicals

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Abstract : Hydrophobic / hydrophilically modified functional polymers are of high interest in modern biomedicine due to their ability to solubilize water-insoluble / poorly soluble (hydrophobic) drugs. Among the many approaches that are being developed in this direction, one of the most effective methods is the use of polymeric micelles (PMs) (micelles formed by amphiphilic block-copolymers) for solubilization of hydrophobic biologicals. For therapeutic purposes, PMs are required to be stable and biodegradable, although quite a few amphiphilic block-copolymers are described capable of forming stable micelles with good solubilization properties. For obtaining micelle-forming block-copolymers, polyethylene glycol (PEG) derivatives are desirable to use as hydrophilic shell because it represents the most popular biocompatible hydrophilic block and various hydrophobic blocks (polymers) can be attached to it. Although the construction of the hydrophobic core, due to the complex requirements and micelles structure development, is the very actual and the main problem for nanobioengineers. Considering the above, our research goal was obtaining biodegradable micelles for the solubilization of hydrophobic drugs and biologicals. For this purpose, we used biodegradable polymers– pseudo-proteins (PPs)(synthesized with naturally occurring amino acids and other non-toxic building blocks, such as fatty diols and dicarboxylic acids) as hydrophobic core since these polymers showed reasonable biodegradation rates and excellent biocompatibility. In the present study, we used the hydrophobic amino acid – L-phenylalanine (MW 4000-8000Da) instead of L-leucine. Amino-PEG (MW 2000Da) was used as hydrophilic fragments for constructing the suitable micelles. The molecular weight of PP (the hydrophobic core of micelle) was regulated by variation of used monomers ratios. Micelles were obtained by dissolving of synthesized amphiphilic polymer in water. The micelle-forming property was tested using dynamic light scattering (Malvern zetasizer NanoZSZEN3600). The study showed that obtaining amphiphilic block-copolymer form stable neutral micelles 100 ± 7 nm in size at 10mg/mL concentration, which is considered as an optimal range for pharmaceutical micelles. The obtained preliminary data allow us to conclude that the obtained micelles are suitable for the delivery of poorly water-soluble drugs and biologicals.

Keywords : amino acid – L-phenylalanine, pseudo-proteins, amphiphilic block-copolymers, biodegradable micelles
Conference Title : ICAMB 2019 : International Conference on Advances in Medical Biotechnology
Conference Location : Barcelona, Spain
Conference Dates : June 11-12, 2019