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Enhancing the stability of nanotheranostic systems

Abstract

Theranostics is new term which defined as a combination of therapy and diagnosis to establish a targeted drug delivery and monitoring of treatment into a single nanosystem. The most important parameter in the theranostic platforms is their stability to be able to increase the crossing some biological barriers and avoid the aggregation in the circulatory system. Therefore, polymeric nanoparticles are highly desirable to design novel nanotheranostics due to their improved pharmacokinetic properties, stability in physiological conditions, biocompatibility, and biodegradability. In our studies, we designed and synthesized some polymeric nanocapsules and one part of these nanocapsules utilized as a pH responsive nanosystem which includes Doxorubicin (Dox), a chemotherapeutic drug, and upconversion nanoparticles (UCNPs) as a luminescent probe and the other part of the nanocapsules were used for the photodynamic therapy (PDT) by loading the capsules with photosensitizer molecules, a derivative of Bodipy. Both studies exhibited excellent stability in phosphate buffered solutions (pH:7.4) which is proved by Zeta-sizer measurements, dynamic light scattering studies and stability tests. The size of the nanocapsules were dramatically decreased by increasing the stirring rate. In the first study, the nanocapsules were loaded with Dox up to ~63 % efficiency and acid-induced release (~47 %) obtained at pH 3.6 and 5.5. It was found that encapsulation decreased toxicity of UCNPs as confirmed in a cellular assay (L-929 and MCF-7 cell lines). In the second study, a higher encapsulation efficiency of Bodipy has been observed. The singlet oxygen measurements of the Bodipy encapsulated nanocapsules have been done in the presence of a trap molecule, resulted in a promising PDT activity. As a result, for both studies, a less soluble drug molecules in solution become highly soluble via encapsulation technology using a polysaccharide nanocapsule. Further studies, such as biological experiments are ongoing.

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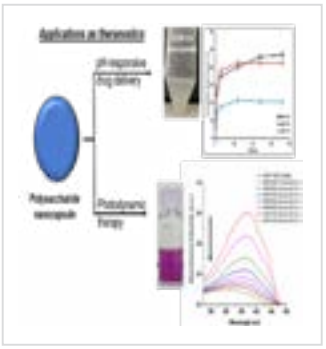
Biography

The author received her M.S degree in Organic Chemistry (2009, Akdeniz University) and PhD degree in Organic Chemistry (2013, Akdeniz University and Bilkent University, Turkey). In the first years of her PhD, she joined the Natural Products group as a researcher at Lund University, Sweden, then continued her PhD studies at National Nanotechnology Research Center (UNAM), Bilkent University, Ankara, Turkey in the field of organic-hybrid nanoparticles for photodynamic therapy (2010-2013). She continued her studies as Post-Doc fellow at the Department of Molecular Sciences, SLU, Uppsala, Sweden and at the Department of Material Science and Engineering, Akdeniz University in 2013-2015 and 2015-2017, respectively. Currently, she is working as an Assistant Professor at the Department of Electrical and Electronics Engineering at Antalya Bilim University, Antalya, Turkey. Her research interests cover the synthesis of light harvesting molecules, luminescent organic dyes, and synthesis of organic-inorganic hybrid nanostructures for theranostic, bio-imaging and controlled drug delivery applications.



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