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NANOCONTAINERS BASED ON BIODEGRADABLE POLYMER AND ANIONIC LIPOSOMES

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Liposomes are widely used in medicine for encapsulation of biologically active compounds. Multi-liposome assembly composed of liposomes loaded with different fillings could enable controlled delivery of the medicines in a desirable ratio. In this work, we suggest a universal approach for preparation of biodegradable multiliposomal containers through electrostatic adsorption of liposomes on the surface of polymer nanoparticles. Firstly, we describe the preparation and properties of nanoconjugates with the "core-shell" structure in which the micellar core from a block copolymer of polylactide and polyoxyethylene is covered by a monolayer of small unilamellar liposomes. It was shown that one micelle could bind 5–6 anionic liposomes. The resulting nanoconjugate was stable in a physiological solution with [NaCl] = 0.15 M. At the same time, the nanoconjugate degraded, being attacked by proteolytic enzymes, down to 10–15 nm particles, that was accompanied by a complete release of the encapsulated antitumor antibiotic doxorubicin into surrounding solution. In the second part of the study, anionic liposomes were adsorbed on the surface of cationic chitosan nanoparticles. Chitosan is a commercially available polycationic biopolymer of natural origin that is known for being biocompatible and biodegradable. Each chitosan particle could adsorb up to 100 anionic liposomes. The conjugates demonstrated stability towards dissociation in physiological media. The complexes were biodegradable, which eventually decomposed after addition of enzymes. It was found that chitosan-liposome complex and the products of its biodegradation were non-toxic in a wide range of concentrations. Thus, the findings of this work seem to be promising in the field of drug delivery. This work was supported by the Russian Science Foundation (project no. 14-13-00255).

Recent Publications

1. **Yaroslavov A A, Efimova A A, Rudenskaya G N, Melik-Nubarov N S, Grozdova I D, *et al.* (2017) An electrostatic conjugate composed of liposomes, polylysine and a polylactide micelle: a biodegradability–cytotoxicity relationship. Mendeleev Communications 27(3):299.**
2. **Sybachin A V, Zaborova O V, Efimova A A, Ballauff M and Yaroslavov A A (2017) Electrostatic complexes of liquid and solid liposomes with spherical polycationic brushes. Polymer Science-Series C 59(1):60.**
3. **Efimova A A, Chvalun S N, Kulebyakina A I, Kozlova E V and Yaroslavov A A (2016) Synthesis and properties of conjugates involving liposomes, a linear polymer, and the micelle of a polylactide–poly(ethylene glycol) block copolymer. Polymer Science-Series A 58(2):172.**
4. **Efimova A A, Zaborova O V and Sybachin A V (2016) Multiliposomal nanocontainers based on anionic solid liposomes and spherical polycationic brushes. Materials Science and Engineering 1(111):22.**
5. **Efimova A A, Sybachin A V, Chvalun S N, Kulebyakina A I, Kozlova E V, *et al.* (2015) Biodegradable multiliposomal containers. Polymer Science-Series B 57(2):140.**

Biography

Anna A. Efimova graduated from Faculty of Chemistry, M.V. Lomonosov Moscow State University. In 1996 defended Ph.D. thesis. Since 1996- Research Scientist, since 2008- Associate Professor at Polymer Department of Moscow State University. In 2004 awarded with the certificate of honour of the Ministry of Education. Author or co-author of more than 40 scientific publications. Research interests are associated with the interaction of polymers and interpolymer complexes with colloid and liposomal dispersions, structural rearrangements in lipid bilayers under the polymer adsorption, polymer-induced transport of small molecules through the lipid membrane, adsorption of liposomes on the surface of (bio) colloids, biodegradable and stimuli-sensitive multiliposomal containers for the immobilization of biologically active substances..

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