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Apoferritin cage nanostructure as the anthracycline delivery system

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Cancer diseases are undoubtedly the most complex diseases known to humanity and one of the greatest problems of the 21st century. The continuous increase in cancer cases is a serious problem in the sphere of prophylaxis and treatment. According to the WHO data, in 2012, the number of newly diagnosed cancer cases was as high as 14 million and the estimated number of new cases per year will increase to 22 million over the next twenty years. During the same period, deaths are projected to increase from 8.2 million to 13 million per year. The strategy of treating cancer is based on three basic methods: tumor removal, toxic chemotherapy and radiotherapy. The most developed method is chemotherapy. However, many anticancer drugs are causing serious side effects. To address the problems with conventional drugs and improve their pharmacological properties, drug-delivery systems (DDS) have been designed for a number of drug-carrier platforms including synthetic (silica, polymers) and natural (lipids, proteins, oligosaccharides) nanocarriers. The most recent development in designing DDS have been focused upon the protein-based nanomedicine platform, due to merits that include high biocompatibility, biodegradability, high solubility, and ease of surface modification. One of the most investigated classes of protein-nanocages is ferritin, which in biological system is used to store iron and to keep it from building to toxic levels in cells. Ferritin/Apoferritin (APO) nanocages have been used to encapsulate a variety of drugs and biologically active substances, including gadolinium contrast agents, doxorubicin, inorganic and magnetite nanoparticles, photosensitizers, organometallic CO releasing systems containing Ru and Mn. Here, we present a drug delivery system to protect the anthracyclines cancer drugs in the apoferritin nanocage. Anthracyclines are the class of drugs used to treat many cancers, including leukemias, lymphomas, breast, stomach, uterine, ovarian, bladder cancer, and lung cancers. Their main adverse effect is cardiotoxicity, which considerably limits their usefulness. Here, we demonstrate the differences in the releasing process of anthracyclines (doxorubicin, epirubicin, daunorubicin and idarubicin) from the APO nanocages. The APO-drug nanocages were prepared by disassembly/reassembly process via pH method. The pH-dependent anthracyclines release was determined using fluorescence spectroscopy.

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