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Immobilization of therapeutic agents on magnetic iron oxide nanoparticles decreases binding to blood serum proteins and increases resistance to enzymatic cleavage

A drug's affinity for binding blood serum proteins, such as albumin, determines a primary interaction affecting its biological activity. Only the free unbound fraction of a drug can induce a therapeutic effect. A range of effective antimicrobial agents, such as peptides containing N3-(4-methoxyfumaroyl)-L-2,3-diaminopropanoic acid (FMDP), are known to be powerful inhibitors of fungal and bacterial growth in vitro; nevertheless, the use of these compounds in clinics has proven intractable due to their irreversible binding of blood serum proteins, causing complete loss of their biological activity. Another limitation, common to FMDP-agents and a range of other peptide drugs, is low stability in blood serum caused by peptidase cleavage. Our studies have demonstrated that the described caveats of certain drugs can be significantly reduced by immobilization on the surface of magnetic iron oxide, Fe3O4, nanoparticles (MNPs). Ibuprofen, immobilized on MNPs, was found to exhibit high antibacterial activity even at a very low concentration and in the presence of albumin in strong contrast to the unattached form of the drug. Furthermore, immobilizing LysNvaFMDP, one of the most potent antifungal agents among the FMDP-peptides, on MNPs decreased its affinity to albumin and other serum proteins compared to its unbound form and resulted in high antimicrobial activity towards bacteria. Finally, our studies proved that the model peptides immobilized on MNPs were more resistant to enzymatic hydrolysis. Together these findings demonstrate the promising utility of MNPs for enhancing therapeutic drug delivery and efficacy.

Biography

Julia Nowak Jary has graduated with an MSc in Biotechnology in 2002 and PhD in Chemistry from the Gdansk University of Technology, Faculty of Chemistry, Department of Pharmaceutical Technology and Biochemistry, Poland in 2009. In May 2008 she held a Research Traineeship at the School of Biological Sciences, University of Wales Bangor, UK. Since 2013 she has been working as a Lecturer and a Researcher at the University of Zielona Gora, Faculty of Biological Sciences, Department of Biotechnology, Poland.

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