

APPLICATIONS OF MAGNETOLIPOSOMES FOR TREATMENT AND PREVENTION

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Magnetoliposomes (MLs) *i.e.* superparamagnetic iron oxide nanoparticles (spions) covered by a lipid bilayer, represent an innovative class of nanosystems that combine the biocompatible and versatile properties of liposomes with the magnetic features of spions. This synergy confers broad potential to MLs in the field of nanomedicine: thanks to their ability to respond to external magnetic fields, MLs can be employed for targeted drug delivery, enhancing drug accumulation at pathological sites while reducing systemic side effects. Additionally, the presence of spions makes them suitable for imaging techniques such as magnetic resonance imaging and for therapeutic approaches like magnetic hyperthermia, where localized heating of tumor tissue can induce selective apoptosis. Recent advances have included the functionalization of the ML surface with specific ligands, making them intelligent tools for personalized medicine and effective tools for simultaneous diagnosis and therapy (*theranostics*). In this light, MLs stand out as multifunctional platforms with strong potential for early diagnosis, monitoring, and targeted treatment across a range of pathologies, especially cancer. Beyond the medical field, MLs have also been applied to the removal of lipophilic organic pollutants from industrial wastewater, which pose a threat to environmental health, wildlife, and human populations. Bisphenols (BPs) are a growing concern regarding water quality and aquatic ecosystems. As emerging contaminants, these largely used compounds are persistent and capable of interfering with biological systems even at low concentrations, thus representing potential risks to human health (*Zhang C. et al., 2016*). BPs have a resistance to traditional treatment (sedimentation and chlorination), and development of alternative methods may be expensive (such as activated carbon filtration or membrane filtration) (*Hu H. et al., 2023*). Consequently, there is an urgent need to find new cheap, rapid and effective systems to reduce the presence of BPs into the environment for their consequence on human health. ML can be a valid approach because BPs present in water partition in the lipid bilayer of ML thanks to their high affinity for the organic phase and then they can be easily removed by magnetic decantation. The removal of BPs from water at different pH was assessed using MLs formulated with structurally related lipids that differ for charge and/or number and length of the alkyl chains. In conclusion, MLs emerge as promising multifunctional platforms for early diagnosis, targeted therapy, and environmental sustainability.