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Development of an electrospun product with ibuprofen-loaded magnetic nanoparticles

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Mesoporous silica nanoparticles stand out as a highly promising nanodelivery system, demonstrating a notable capacity for loading both small molecules and biomacromolecules. Their preparation is simple, reproducible, cost-effective, and well-known [1]. Combining such nanoparticles with a superparamagnetic core yields an advanced drug delivery system exhibiting the benefits of mesoporous silica and magnetic nanoparticles (MNPs) [2].

The aim of this study was to develop a method for loading a poorly soluble model drug, ibuprofen, into the mesoporous silica coating of MNPs and to couple the drug loading process with subsequent drying of the prepared dispersion through electrospinning. The drug loading was based on drug adsorption from an ethanol-based solution, employing ultrasound and overnight incubation. After drug loading, the MNPs were magnetically separated from the solution with an excess of ibuprofen and redispersed in the polymer solution. The nanofiber-forming polymer used was hydrophilic polyethylene oxide, supplemented with poloxamer 188 to enhance nanofiber dissolution and to stabilize the reconstituted MNP dispersion. By systematically varying the drug-loading and electrospinning parameters, we developed a procedure that enabled the preparation of nanofibers with ~20% (w/w) of MNPs, which were loaded with up to 20% (w/w) of ibuprofen. Further investigations demonstrated a correlation between the ibuprofen loading capacity in MNPs and the pore sizes in the mesoporous coating of MNPs. With the developed method we have prepared a solid non-powder formulation of ibuprofen loaded MNPs, which enables rapid and simple reconstitution of MNPs just prior to their application.

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