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Controlled delivery of drugs adsorbed onto porous Fe_3O_4 structures by application of AC/DC magnetic fields

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In this reserch we demonstrate that porous Fe_3O_4 structures can be used as a vehicle for the transport of drugs adsorbed onto their porous surface. We used methyl blue as a surrogate drug. It was adsorbed onto the Fe_3O_4 surface, and released into the surrounding water via application of a magnetic field. Controlled release of the methyl blue to water was then achieved by application of a magnetic field. Application of a pure AC field caused release of the methyl blue. However, a combination of both DC and AC fields resulted in much faster release. This study demonstrates a concept for controlled drug delivery, where pharmaceutical molecules, similar to methyl blue, would be adsorbed onto porous Fe_3O_4 structure and then released at a target by application of appropriately localised magnetic fields. Furthermore, we developed superparamagnetic nanoparticles for activation of the MscL nanovalves incorporated in liposome by magnetic field. Synthesised $CoFe_2O_4$ nanoparticles were labelled by -SH groups for attachment to MscL channels. Activation of MscL by magnetic field with the nanoparticles attached was examined by the patch clamp technique showing that the number of activated channels under ramp pressure increased upon application of the magnetic field. A combination of MscL channels and the magnetic nanoparticles generated for this study holds promise for use in the development of "smart liposomes", a new generation of liposome drug delivery system.

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Production of polymeric menthol nanoparticles by solvent displacement method

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This work was carried out with the aim to produce menthol-loaded PEG nanoparticles for transdermal application (NP's) using two intensive mixers namely confined impinging jet mixer (CIJM) and multi inlet vortex mixer (MIVM) with similar polymer, solvents and operating conditions. Influence of various process parameters such as polymer and menthol concentration, flow rate, solvent type, quench ratio etc., on mean nanoparticle size, zeta potential, menthol loading and encapsulation efficiency were compared and investigated. The amount of menthol encapsulated inside the nanoparticles was quantified by gas chromatography. In addition, for further investigation about the structure, texture, shape and size the NP nanoparticles were analyzed with TEM technique. A simple equation showing the dependence of mean nanoparticles size on initial polymer concentration, mass ratio, flow rate (or inlet stream velocity) was proposed and by experimental investigation parameters it was confirmed. Nanoparticles of size between 200 nm to 800 nm were produced using the CIJM and MIVM with different configurations. It was observed that the CIJM mixer produced larger mean nanoparticle size as compared to two (MIVM-2) and four (MIVM-4) sided streams vortex mixers and; as concerns the influence of the solvent, larger mean nanoparticles were obtained with acetonitrile as compared to acetone. Encapsulation efficiency and menthol loading increased with increasing menthol and polymer concentration during the nanoparticles synthesis. Few experiments with miglyol oil were also carried out with the aim to optimize NP mean size.

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