Nanochemical and Nanobiotechnology

Influence of molecular size on physicochemical and pharmacokinetic properties of selected drugs encapsulated into SBA-15

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Nifedipine and nimodipine are both 1,4-dihydropiridine derivatives suffering from very low solubility in water and body fluids (IIIrd class BCS). Despite being commonly used for many years in hypertension treatment, this disadvantage requires them to be continuously applied inside the body with much higher doses.

In order to improve low solubility of these compounds, some kind of nanocarriers may be implemented. Especially ordered mesoporous silica materials seems to be ideal candidates due to their ability to adsorb pharmaceutical ingredients and high level of biocompatibility.

The main aim of my study was to investigate whether different molecular sizes of similar drugs influence the final properties of such systems. The studies were performed on two samples: nifedipine and nimodipine encapsulated into hexagonally arranged mesoporous silica material SBA-15 with a mean pore diameter of 6.2 nm. They were both prepared from the same matrix using modified solvent method in dichloromethane environment. In addition, the influence of washing procedure was also verified.

As a result of detailed physicochemical analysis, it was possible to confirm that after encapsulation, systems containing nifedipine and nimodipine exhibit slightly different structural behavior and physicochemical properties. In particular, drug loading level (TGA) after washing procedure is almost doubled for nifedipine with reference to nimodipine. Furthermore, for nifedipine (irrespective of washing) partial crystallinity is observed, while for nimodipine the final system is fully amorphous (DSC, XRPD, ^{13}C HR NMR). As a result of this phenomenon, different dynamical properties are revealed (^{1}H NMR), according to crystalline and amorphous state of nanoconfined drug. Finally, all factors mentioned above strongly influence drug release profiles, which are a crucial point in practical application of these systems in the future.