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Coupling nanoprecipitation microfluidic techniques and spray drying for preparing high-quality dry-state drug-loaded monodisperse polymeric nanoparticles at high throughput

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We will present a new two-step process for the preparation of dry-state drug-loaded polymeric nanoparticles with tunable size and narrow size distribution. At first a polymer solution composed of few weight percentage of a polymer dissolved in an organic solvent was admixed with a model drug (ketoprofen) and surfactant. The resulting mixture was then nanoprecipitated in flow by means of a micromixer with a stream of non-solvent (water) to produce a colloidal suspension of drug-loaded polymeric nanoparticles at a throughput of 1.5 kg/d. Depending on the operating conditions (water and polymer solution flow rates, type of micromixers), nanoparticles with sizes ranging from 100 to 200 nm and narrow size distribution (as seen by light scattering PDI below 0.2) were obtained. In a second step, the nanosuspension was admixed with manitol and surfactant and finally dried with a mini spray dryer B-290 (Buchi). Encapsulation efficiency and drug release rate of dry-state nanoparticles were determined and compared with those of non-dried nanoparticles. First, it was found that up to 90% of the encapsulated drug can be released in 7 hours. Furthermore the drug release kinetics can be tuned by varying the size of the nanoparticles. Second, dry-state nanoparticles encapsulation efficiency and drug release rate were observed to be systematically lower by 10 to 15% compared to their non-dried counterparts. It was thus demonstrated that the developed two-step process is a robust method to produce dried-state polymeric drug nanocarriers that can be stored safely and redispersed easily for drug administration. Moreover, drug release rate and kinetics can be tuned easily upon variation of operating parameters.

Biography

Shukai Ding is currently a PhD student at Strasbourg University. He has completed his Master at Xi'an Jiaotong University. His research work concerns the development of new microfluidic processes for the production of drug polymeric micro and nanocarrier.

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