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Applications of electrospinning/electrospraying in drug delivery

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Summary

During recent years, nanoscaled materials have gained much attention because of their applications in the field of pharmaceutical and biomedical sciences. Electrospinning/electrospraying, as simple, effective and single-step methods, are used in the preparation of nanostructured materials (nanofibers and nanobeads). They offer an opportunity for direct encapsulation of the different types of drug molecules. The generated nanomaterials possess high surface area with porous characteristics, and the liberation of the loaded drugs follows a controlled-release pattern. Because of their wide applications in medical/pharmaceutical researches, the aim of this editorial is to highlight the importance of electrospinning/electrospraying technologies in drug delivery.

Authors Biosketch

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During recent decades, nanoscaled drug delivery systems (DDSs) have gained much attention in the area of pharmaceutical and biomedical applications.[1] Nanosized delivery systems are able to improve the physicochemical as well as the pharmacokinetic properties of either water-soluble or -insoluble drugs in the case of both local and systemic drug deliveries. Nanostructured materials are very beneficial for drug delivery purposes because of their several outstanding attributes such as (a) reduced particle size; (b) efficient drug transport; (c) the ability to target cells, extracellular origins, or special organs in the body; and (d) avoidance of unwanted mucociliary clearance and epithelial phagocytosis as well as reduction of undesirable reticuloendothelial uptake. Hence, delivery of drugs using nanosized DDSs, with novel and desired properties, has great potentials for a wide range of medical and pharmaceutical applications.[2-5] Among different nanoparticle preparation techniques, electrospinning is known as one of the effective methods for the preparation of nanostructured materials.[6] Electrospinning technique has been introduced as a method that employs the electrostatic force as a driving force for the fabrication of fibers in different shapes and sizes. In this method, a desired polymeric solution is subjected to a high electrostatic force, which results in the formation of fibers or particles. This procedure is usually called electrospraying when it leads to formation of nanoparticles (nanobeads) instead of nanofibers. The morphology and properties of the obtained nanoparticles or nanofibers are affected by several factors including process parameters (e.g., applied voltage, flow rate, distance between nozzle and collector, and size of the nozzle orifice), solution parameters (e.g., concentration, viscosity, conductivity) and ambient parameters (e.g., ambient temperature and humidity).[7] Normally, an increase in the electrospraying solution concentration leads to higher viscoelastic forces, which could dominate the surface tension and initiate the fiber formation. The higher loading efficiency, the narrower particle-size distribution. The simplicity of preparation (due to single-step nature of the process) are the main prominent indicators of the electrospinning/electrospraying methods.[8] Furthermore, these techniques offer great opportunity for the direct encapsulation of various types of drug molecules (hydrophobe, hydrophile, and biomacromolecules) into the electrospund structures. Thus, electrospinning and electrospraying methods seem to be promising pro-

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cedures for the fabrication of drug-loaded micro and/or nanoparticles. In addition to the controlled-release property of the nanostructured samples, other special features such as drug amorphization during the electrospinning process, high surface area and also porous characteristics of these constructions, help to improve the dissolution profile of poorly water-soluble drugs and provide a more efficient DDS.[9] Finally, adverse effects relevant to some undesired fluctuations in drug concentration or ineffectiveness of drug molecules could be lowered.[8] Based on literature review, triamcinolone acetonide-PLGA and triamcinolone acetonide as well as methylprednisolone acetate Eudragit RS100™ nanofibers/nanobeads with prolonged anti-inflammatory effects,[9-11] diclofenac sodium Eudragit L 100-55™ [12] and indomethacin nanofibers[13] for the colon targeting and azithromycin Eudragit RS100 nanofibers/nanobeads for the sustained and effective delivery of antibiotic molecules into the infected tissues,[14] have been prepared by electrospinning and/or electrospraying methods. Moreover, improvement in dissolution profile of several poorly water soluble drugs such as acetaminophen,[15] ketoprofen,[16] itraconazole,[17] and ferulic acid[18] have been performed benefitting these techniques. Dissolution improving effects of these electrospunned samples were more prominent than the conventional solid dispersions, in large part due to their large surface area, high porosity and more homogeneous distribution of the drug into the electrospunned or electrosprayed samples.[15] In conclusion, according to the mentioned advantages of electrospinning/electrospraying processes, it seems that they could be considered as efficient industrializable techniques in the field of DDSs.

Ethical approval

Not applicable.

Competing interests

There is none to be declared.

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