Editorial

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Application for Nanoparticle Interaction with Drug Delivery Systems

Abstract

Nanomedicine and Nano-delivery systems are a relatively new but rapidly developing science where materials in the nanoscale range are employed to serve as means of diagnostic tools or to deliver therapeutic agents to specific targeted sites in a controlled manner. Nanotechnology offers multiple benefits in treating chronic human diseases by site-specific and target-oriented delivery of precise medicines. Recently, there are a number of outstanding applications of the nanomedicine in the treatment of various diseases. The current review, presents an updated summary of recent advances in the field of nanomedicines and nano based drug delivery systems through comprehensive scrutiny of the discovery and application of nanomaterials in improving both the efficacy of novel and old drugs and selective diagnosis through disease marker molecules. The opportunities and challenges of nanomedicines in drug delivery from synthetic/natural sources to their clinical applications are also discussed. In addition, we have included information regarding the trends and perspectives in nanomedicine area.

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Introduction

Since ancient times, humans have widely used plant-based natural products as medicines against various diseases [1]. Modern medicines are mainly derived from herbs on the basis of traditional knowledge and practices. Nearly, 25% of the major pharmaceutical compounds and their derivatives available today are obtained from natural resources. Natural compounds with different molecular backgrounds present a basis for the discovery of novel drugs [2]. A recent trend in the natural product-based drug discovery has been the interest in designing synthetically amenable lead molecules, which mimic their counterpart's chemistry. Natural products exhibit remarkable characteristics such as extraordinary chemical diversity, chemical and biological properties with macromolecular specificity and less toxicity. These make them favorable leads in the discovery of novel drugs. Further, computational studies have helped envisage molecular interactions of drugs and develop next-generation drug inventions such as target-based drug discovery and drug delivery.

Despite several advantages, pharmaceutical companies are hesitant to invest more in natural product-based drug discovery and drug delivery systems and instead explore the available chemical compounds libraries to discover novel drugs [3]. However, natural compounds are now being screened for treating several major diseases, including cancer, diabetes, cardiovascular, inflammatory, and microbial diseases. This is mainly because natural drugs possess unique advantages, such as lower toxicity and side effects, low-price, and good therapeutic potential. However, concerns associated with the biocompatibility, and toxicity of natural compounds presents a greater challenge of using them as medicine. Consequently, many natural compounds are not clearing the clinical trial phases because of these problems [4]. The use of large sized materials in drug delivery poses major challenges, including in vivo instability, poor bioavailability, and poor solubility, poor absorption in the body, issues with target-specific delivery, and tonic effectiveness, and probable adverse effects of drugs. Therefore, using new drug delivery systems for targeting drugs to specific body parts could be an option that might solve these critical issues. Hence, nanotechnology plays a significant role in advanced medicine/drug formulations, targeting arena and their controlled drug release and delivery with

immense success.

L. Gómez-Segura et al. investigated the ex vivo permeation of carprofen (CP) 2-(6-chlorocarbazole) propionic acid across different classes of porcine mucous membranes and ophthalmic linings to differentiate between the CP-NP formulation and a CP solution. The results showed that CP-NPs provide advantageous situations in most tissues. The structure of the material is not modified, being more effective and safer than the CP solution [5]. This research opens the door to successfully test in situ treatments of many inflammatory diseases in animals or people.

P. M. Castillo et al. working in the field of disease detection using nanosystems, have carried out a new method to determine urinary lysozyme content within a concentration range that is associated with monocytic and myelomonocytic leukemia, among other diseases [6,7]. The authors describe a method based on obtaining CIELab parameters described by the CIE. The advantages of the method involve a very low cost and an extremely short detection time. In addition to being fast and economical, the described method does not require specialized personnel in the knowledge of specific analytical techniques. The required equipment implies having a commercial spectrophotometer or colorimeter, and a positive case can even be detected through an evaluation of the color with the naked eye with a reference solution [8].

A. Gomes et al. have developed an exhaustive study of the interaction energy between lysozyme and the surface of gold nanoparticles surrounded by citrate ions, considering with special attention those factors that can directly influence the performance of colloidal gold systems for the detection of the protein. Specifically, authors have analysed the stability of colloidal gold solutions, the influence of the diameter of the nanoparticles and the correct way to express the concentration of gold in the nanosystem to obtain the best and most accurate results [9]. They found that the state of saturation implies an average number of 55 Lys per gold nanoparticle. Studies about the use of different materials as nanocarriers should meet important requisites such as biocompatibility, biodegradability and non-immunogenicity. The toxicity associated with numerous drugs and classical galenic formulations or the complexity to treat diseases have progressed the prompt development of new alternatives to drug-eluting nanosystems [10]. In this sense, polymers are macromolecules synthetized via a covalent union of one or different monomers that possess at least two functional groups, where they can react easily to constitute a chain to attain specific properties. Polymeric nanoparticles are not only pharmaceutical entities that may exhibit all the above-mentioned characteristics: their rich synthetic versatility allows them to be greatly customized to accomplish the final requirements. Particularly, polymeric nanoparticles for ocular drug delivery, for cancer diagnosis and treatment, as well as nutraceutical delivery, have been described in detail, as well as an interesting discussion concerning the future prospects of these systems [11].

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