Editorial

Applications of Solid Lipid Nanoparticles (SLN) and Nanostructured Lipid Carriers (NLC): State of the Art

Currently lipid nanoparticles, i.e. solid lipid nanoparticles (SLN) and nanostructured lipid carriers (NLC), are well-established systems for therapeutic and cosmetic uses. These applications were first suggested in the nineties of the 20th century for SLN, and upgraded about 10 years later by the invention of NLC. Since then, the number of researchers studying these systems has been increasing, due to the attractive advantages that have been pointed to SLN and NLC, when compared to other colloidal carriers (e.g. polymeric nanoparticles, micelles and nanoemulsions). For example, the use of non-toxic raw materials (physiological lipids and GRAS surfactants) and organic solvents during production circumvents toxicity in the final formulations. Furthermore, these systems can be produced using simple equipment that are usually available in research laboratories, such as high-speed stirrers and sonication probes. Therefore, it is surprising that nowadays few lipid nanoparticles-based cosmetic products are in the market and there are no therapeutic systems under clinical use. Possible reasons for this are the complex regulatory issues that must be addressed before medicines commercialization, and the observed in vivo failure of some lipid nanoparticles-based therapeutic systems, indicating that more preliminary in vitro and ex vivo experiments should be performed before passage to clinical trials. Moreover, unexpected in vivo adverse effects, related to the ability of these nanosystems to cross biological membranes and undertake tissue deposition, are not fully understood.

To recognize the recent progresses and organize the most relevant published data regarding SLN and NLC studies, this special issue brings together fourteen review articles, from different worldwide experts, updating the state of the art of using lipid nanoparticles for therapeutics and cosmetics.

Ana C. Silva et al. (University of Porto, Portugal) present the advantages of using SLN and NLC for direct nose-to-brain drug delivery to improve the treatment of neurodegenerative diseases. The authors report in vitro, ex vivo and in vivo experiments showing promising results, although more in vivo animal studies are required for advance to human clinical trials [1].

João Nuno Moreira et al. (University of Coimbra, Portugal) emphasize the potential of using lipid-based nanoparticles for targeting both cancer stem cells and non-stem cells. The authors present multiple cell-targeting strategies, such as surface markers and/or signaling pathways that are aberrantly activated and contribute to cancer stem cells proliferation and survival. The potential of lipid-based nanoparticles to target different tumor cell populations is also discussed [2].

Melike Uner et al. (University of Istanbul, Turkey) summarize the key features of SLN and NLC for improve drug delivery. The most relevant researches related to administration via different routes and market formulations are presented [3]. On this matter, Divyesh Shastri (K. B. Institute of Pharmaceutical Education & Research, India) describe the different SLN and NLC delivery routes and strategies to enhance drug bioavailability and therapeutic efficacy [4]. A comprehensive report on patents, preclinical and clinical aspects related to lipid nanoparticles is reported by Kamla Pathak et al. (Pharmacy College Saifai, India) [5].

Ragwa Farid et al. (Pharos University, Egypt) discuss the effect of lipids and surfactants in the production of lipid-based nanocarriers, with regard to their behavior and physicochemical characteristics. As described by the author, recent studies revealed that the properties of SLN and NLC (e.g. particle size, drug loading, zeta potential, drug release, stability, permeability and cytotoxicity) might be affected by the type and amount of lipids and surfactants of the formulation [6]. In this sense, Andonova et al. (Medical University of Plovdiv, Bulgaria) provide detailed information about the techniques for SLN and NLC characterization, such as particle size, surface charge, morphology, crystallinity, encapsulation efficiency, in vitro release, stability tests, sterilization and toxicity assessment [7].

Guillermo Castro et al. (National University of La Plata, Argentina) bring up the main aspects related to hybrid lipid nanoparticles, such as methods for synthesis and characterization and toxicological properties, administration routes, drug encapsulation strategies, tailoring and targeting, and potential for use in biomedicine [8].

Marcelo B. de Jesus et al. (University of Campinas, Brasil) highlight the use of SLN and NLC for drug delivery to the oral mucosa, skin and eye. The authors suggest the strategies that might be employed to improve lipid nanoparticles topical application, and critically analyse the in vitro and in vivo experiments that have been carried out to evaluate the performance and toxicity of these systems. The main points that should be overcome for topical SLN and NLC formulations reaching the market are the standardization of in vitro and in vivo tests and the development of specific toxicity tests [9]. In a more specific approach, Evren Gökke et al. (University of Ege, Turkey) review the recent developments on ophthalmic SLN and NLC formulations, improving the therapeutic efficacy and reducing side effects. The authors present recent studies and discuss the limitations of these systems [10]. Tais Gräteri et al. (University of Brasilia, Brasil) discuss the potential use of lipid nanoparticles in managing skin and nail mycoses, underlining their unexplored use in onychomycosis. The authors state that the success of SLN and NLC for promoting antifungal cutaneous delivery indicates their potential for enhancing nail hydration and drug penetration into the nail plate [11].

Rosario Pignatello et al. (University of Catania, Italy) describe the benefits of using SLN- and NLC-loaded fluoroquinolones, with focus on the latest technological developments that have led to significant improvements on the antibiotics pharmacokinetics and pharmacodynamics. From their review, the authors concluded that there is a need to use standardized microbiological investigative methods for accurately comparing the results presented in literature [12].

Xingwang Zhang et al. (Jinan University, China) evidence the potential of SLN and NLC for improve the delivery of active natural medicines, in particular by oral, intravenous, percutaneous and ocular routes [13]. Salma Tammam (German University in Cairo, Egypt) discusses the different types of lipid nanoparticles and the potential held by their excipients for cancer multidrug resistance reversal. The author describes how lipid nanoparticles might successfully support the multidrug resistance reversal, when compared to the use of free excipients [14].

We would like to thank all the authors of this special issue for contributing with high quality manuscripts. We are also very grateful to all the reviewers, who had the kindness of critically evaluating the articles. In addition, we would like to thank the Editor-in-Chief of Current Pharmaceutical Design, Professor William A. Banks, for giving us the opportunity of organizing this special issue, and to the publishing team (Mr. Kazim Baig and Mr. Aamer M. Khan) for their kind help.
REFERENCES


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