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Editorial

New Insights into Advanced Drug Delivery and Absorption Systems

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The therapeutic effect of a drug depends on the method of effective delivery of the active ingredient to the site(s) of the pharmacological target area. For drugs, acting systemically the aspects of LADME, and specifically, liberation and absorption, are the most important factors to determine the proper dose and delivery of the active ingredient for the sought out therapeutic response. Therefore, the active ingredient (API) should be absorbed by the desired route of administration at a suitable rate, which is required to reach an adequate therapeutic concentration at the receptor sites and consequently, to deliver its pharmacodynamic effect(s). Design methodology and formulation processes creating a drug delivery system (DDS) require consideration of the physical, chemical, and biologic characteristics of the finished medicinal product together with knowledge of the pharmaceutical properties of API and all the auxialiry pharmaceutical materials. In practice, that means that for a modern DDS, all of these factors should be determined based on the capacity to influence the pharmacokinetics by affecting any on the LADME parameters. Therefore, during the development of drug delivery technology, the drug release profile, including absorption, distribution and elimination, may be modified to achieve an effective and patient convenient dosage and formulation.

The research area related to drug delivery design represents a broad and ever-growing topic. This Special Issue entitled "New Insights into Drug Delivery and Absorption", is intended to illustrate some of the recent findings in the fields related to the design and developments of drug delivery systems. The aim of these review articles is to gain knowledge by acquiring specific information about DDS topics, understand the main research goals in this field and get insight into recent issues that the pharmaceutical formulation industry has faced to date.

Fundamental principles and the potential for alternative drug delivery to CNS across the blood–brain barrier (BBB) are reviewed by A.L. Bors and F. Erdő [1]. The diverse structural elements and specific anatomical features of the system with its particular transport properties play a crucial role in the drug's ability to pass through the BBB. Various blood–brain barrier models have been summarized in their article, such as in vitro (static and dynamic), in vivo (microdialysis), and in situ (brain perfusion) models. The possible carrier systems, like nanocarriers, nanoparticles, viral and peptide vectors are reported; those are hopefully useful tools to enhance brain exposure to therapeutic compounds. The most efficient invasive (direct brain administration or implants by biodegradable polymeric matrix) and also advanced non-invasive techniques, such as intranasal administration or ultrasonography-guided microbubbles (MBs) providing a localized real-time control of drug delivery are also introduced as a potential delivery route in order to bypass the blood–brain barrier and target the various brain regions.

Although the main role of the skin is to protect the body from harmful external environment by creating the strongest barrier system in our body, this tissue represents one of the most innovative and exciting areas in drug delivery research. A lot of technological development has been realized in this area in order to optimise drug release in topical and transdermal therapy systems (TTDS). S. Berkó and her group [2] summarized, in a recent (2019) review, the most up-to-date methods evolving to

evaluate techniques for the in vitro cutaneous penetration of drugs. Expanding the knowledge about the main in vitro methods that aim to study the drug diffusion and distribution within the layers of the skin are considered useful tools that support the early phase research in pharmaceutical dermal drug delivery systems.

Ocular drug delivery systems, due to the anatomical complexity and structure of the defensive mechanisms of the eye (tear production, drainage, etc), are still considered as a great challenge to develop the optimal formulations for various eye diseases. The mini-review by T. Bíró and Z. Aigner [3] describes the relevant theoretical background and the current pharmaceutical approaches in the field of drug delivery in ophthalmology. The most recent strategies for research-based formulation processes and innovative products that enable either or both to increase the permeability of the active ingredients with better solubility of the active pharmaceutical ingredient or to enhance the retention time in the ocular surface for prolonged ocular drug delivery are under the early phase of development.

To improve therapeutic and technological advantages of drug delivery systems (DDS), various microparticles, microspheres, and microcapsules are widely used to fabricate advanced multi-particulate DDS and a great number of polymers have been tested recently. These delivery systems have well defined physiological and pharmacokinetic benefits with better effectiveness and tolerability. In the overview by I. Antal and his co-workers [4], the concept for formulation and its practical application have been summarized by the pharmaceutical technology, the API release mechanisms, the applied excipients and production processes of the microparticles. The physiological-anatomical advantages of microcarriers over nanoparticles highlighted the potential benefits of utilizing the technology. Overall, it is concluded that as these state-of-the-art structures offer a realistic opportunity for a precise control of drug release in order to optimize the pharmacokinetic profile and increase the drug safety.

Pharmaceutical excipients play a crucial role in the development of the drug delivery system. Cyclodextrins (CDs) have been widely used as excipients and there is an ongoing scientific interest in utilising them in advanced pharmaceutical industrial formulations. Due to their beneficial characteristics, such as low solubility and high permeability (BCS Class 2), the enhancement in bioavailability of poorly water-soluble drugs by complexation has been explored by several investigations in recent decades to highlight their potential benefits in formulations. In the summary by F. Fenyvesi et al. [5], the most common application of cyclodextrins to an advanced form host–guest inclusion complexe that enhances the solubility of poorly soluble active agents have been discussed in details. As an example, CDs are able to improve absorption across biological barriers with a probably endocytotic manner that resulted in the formulation of a novel product registered as an orphan drug in genetic Niemann's-Pick disease.

Nowadays, the unfortunately pandemic Coronavirus infection (COVID-19) is not just a new challenge that has appeared almost everywhere in the World, it is also having a huge impact on national and international health care systems as well for industries. New efficient, safe and properly designed vaccines, as expected are required not only for COVID-19, but also for many other diseases that still lack effective medicinal treatment. Jahan et al. [6] recently reported the potential use of solid vaccines that can increase the efficacy of vaccination by inducing mucosal and systemic immunity as well. They introduced different routes of vaccination by a solid dose delivery system which is currently under development. These solid dose vaccines may have many advantages: applying needle-free technologies, these systems are designed to avoid being in direct contact with the bloodstream, e.g., increasing their safety but also expecting to have a high thermostability (e.g., reducing the need for a cold-chain distribution and storage conditions). Hopefully, as the next step of development, the aim will be to increase patients' compliance with an advanced formulation that combines both the prime and booster shots in a single administration.

I hope that readers of Scientia Pharmaceutica find this Special Issue informative and useful in summarizing the updates in research and the recent approach of drug development technologies in this dynamic and rapidly evolving pharmaceutical industry.

Conflicts of Interest: The author declares no conflict of interest.

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