Journal of Pharmaceutics & Drug Delivery Research

Commentary A SCITECHNOL JOURNAL

Investigational Perspectives on the Advancements in Drug Delivery Systems

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Received date: 01 January, 2023, Manuscript No. JPDDR-23-89400;

Editor assigned date: 03 January, 2023, PreQC No. JPDDR-23-89400 (PQ);

Reviewed date: 17 January, 2023, QC No. JPDDR-23-89400;

Revised date: 24 January, 2023, Manuscript No. JPDDR-23-89400 (R);

Published date: 30 January, 2023, DOI: 10. 4172/2325-9604.1000206

Description

Drug Delivery Systems (DDS) have significantly revolutionized the field of medicine by facilitating the targeted delivery of therapeutic agents to the specific sites of the body. It aims to achieve maximum efficacy of the drug with minimum toxicity and side effects. The advancement in DDS has opened new avenues for researchers to develop innovative and advanced drug delivery technologies. This article will provide an overview of the various drug delivery systems, their applications, and recent advancements.

Traditional drug delivery systems mainly relied on oral administration, but their effectiveness was limited due to the low bioavailability of the drug [1]. This led to the development of novel DDS, including transdermal patches, inhalation, and implantable systems. Transdermal patches offer a non-invasive way of drug administration through the skin, ensuring sustained release of the drug into the bloodstream. Inhalation is another alternative method of drug administration for the treatment of pulmonary diseases [2]. Implantable DDS is another advanced technology that provides long-term delivery of the drug at the targeted site.

Nanoparticles are the latest drug delivery systems that have gained widespread attention in the past few decades. Nanoparticles are carriers that enable the encapsulation of the drug within the Nano scale size range. These particles have shown significant potential in improving drug efficacy and bioavailability. They can be synthesized using biodegradable polymers, lipids, or metals. Nanoparticles have a high surface area to volume ratio, enabling them to carry a high amount of drug molecules. Furthermore, they can target the specific cells or tissues by conjugating with specific ligands, enhancing the therapeutic effect of the drug.

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Liposomes are another form of DDS that consist of a phospholipid bilayer surrounding an aqueous core. They are biocompatible, biodegradable, and can carry both hydrophilic and hydrophobic drugs [3]. Liposomes are useful in treating cancer, as they selectively accumulate in the tumor site, reducing the toxicity of the drug to the normal cells.

Polymeric DDS are also extensively used for drug delivery applications. These polymers can be synthetically modified to control the release rate of the drug. Polymeric DDS can be prepared in the form of microspheres, nanoparticles, or hydrogels. They can provide sustained release of the drug for a prolonged period, reducing the frequency of drug administration [4].

Recently, stimuli-responsive drug delivery systems have gained much attention. These systems are designed to release the drug in response to specific stimuli, such as temperature, pH, or light. The stimuli-responsive DDS can provide targeted drug delivery and can release the drug at a specific site of the body. The stimuli-responsive systems can improve the bioavailability of the drug by reducing the loss of the drug to the surrounding tissues.

Advancements in DDS have led to the development of smart drug delivery systems that incorporate electronics and nanotechnology. These systems are capable of real-time monitoring and control of drug delivery, enhancing the therapeutic efficacy of the drug [5]. Smart DDS can be programmed to release the drug at a specific time or in response to the biological signals of the body. These technologies have significant potential in improving patient compliance and drug efficacy.

Conclusion

The advancements in DDS have facilitated the targeted delivery of drugs with enhanced efficacy and reduced toxicity. Nanoparticles, liposomes, and polymeric DDS are extensively used in drug delivery applications. Stimuli-responsive and smart DDS are recent innovations that have gained much attention. DDS has opened new avenues for the development of novel and advanced drug delivery technologies, enhancing patient care and clinical outcomes.

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Citation: *Walpole C (2023) Investigational Perspectives on the Advancements in Drug Delivery Systems. J Pharm Drug Deliv Res. 12:1*