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EMERGING TRENDS IN NOVEL DRUG DELIVERY SYSTEMS FOR ENHANCED BIOAVAILABILITY AND TARGETTED DRUG ACTION

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ABSTRACT

Plants possess medicinal properties and are utilized by humans. Since ancient times, soil has served as both food and medicine. In the contemporary world, the exploration of herbs within laboratory settings, along with preliminary testing and subsequent analysis, has proven beneficial for drug users. This progress has paved the way for the production of herbal products through advancing technology. Recent advancements in our understanding of the pharmacokinetics and pharmacodynamics of drugs offer a more rational basis for creating optimal drug delivery systems. It is clear that collaborative efforts across various disciplines will be crucial for the future success of drug delivery research. Through the implementation of sophisticated techniques, it is feasible to achieve protection against toxicity, enhance stability, improve bioavailability, and safeguard against both chemical and physical degradation of herbal formulations, all of which must yield results in a more efficient or expedited manner. Although traditional medication delivery methods are widely utilized, they are less effective compared to more innovative and modern drug delivery technologies. If the concentration of a drug falls outside the appropriate range, it can either be detrimental or fail to provide any therapeutic benefit. The approach to delivering medications to targeted tissues is becoming increasingly essential, especially given the relatively limited progress in treating severe diseases effectively.

Keywords: *Drug delivery system, target site, drug, drug carrier, therapeutic dose, pharmacological effect.*

1. INTRODUCTION

There exists a wide array of New Drug Standard (NDDS) carriers, each differing in quality. Traditional formulations encounter issues such as overdose, instability, delayed effects, fluctuations in plasma concentration, and rapid release. The fundamental aspects include efficacy, protection, patient adherence, and product longevity [1]. A novel drug delivery system serves as an overarching term that encompasses innovative techniques and tools designed to enhance the therapeutic effectiveness of medications. By employing a range of strategies, including nanotechnology, specialized carriers, targeted distribution, and implanted devices, as well as polymer science, pharmaceutical advancements are being made.[2]

2. HISTORY OF NOVEL DRUG DELIVERY SYSTEM

The advancement of drug delivery technologies can be characterized in various manners, such as by therapeutic classes and delivery paradigms. In this context, the evolution is outlined by the introduction of new technologies that utilize products sanctioned by illustrates significant milestones in drug delivery systems that have influenced the development of controlled drug delivery systems. Although drug delivery technologies are continually improving, the definitive indicator of a formulation's success is its demonstrated safety and efficacy, as evidenced by FDA approval, which allows patients to take advantage of these new technologies. The limitations associated with conventional dosage forms prompted the creation of advanced and innovative methods known as Novel Drug Delivery Systems (NDDS).

3. FACTORS AFFECTING NDDS

3.1 Physicochemical properties of a drug
3.2 Route of administration
3.3 Acute / Chronic therapy [3]

4. CARRIER BASED DRUG DELIVERY SYSTEM

4.1. Liposomes
4.2. Nanoparticles
4.3. Microspheres
4.4. Niosomes
4.5. Resealed erythrocytes as drug carriers

4.1. liposomes

Liposomes are drug-based, self-assembling phospholipid based vesicles that surround a core aqueous compartment in the shape of a concentric series of several bilayers (multilamellar) or a bilayer (uni-lamellar) [4]. The phospholipid bilayer of liposomes is 4-5 nm thick, and their sizes range from 30 nm to the micrometre scale5 [4, 5-8]. To increase patient compliance and treatment efficacy, various delivery routes, including parenteral, pulmonary, oral, transdermal, ocular, and nasal routes, have been established

4.2.Nanoparticles

Generally speaking, a particle of matter with a diameter of one to one hundred nanometers (nm) is referred to as a nanoparticle or ultrafine particle [9,10]. The phrase can also refer to fibres and tubes that are less than 100 nm in just two directions, or larger particles up to 500 nm28. In the lowest range, metal particles that are smaller than one nanometre are typically referred to as atom clusters

4.3. Microspheres

Another name for the microspheres is micro-particles. They are made to improve a drug's therapeutic efficacy and address some of the issues with traditional therapy. To achieve the intended effect, the drug must deliver the maximum therapeutic effect and the least amount of side effects to the target tissue at the right time. The prolonged release of the anticancer drugs and their ability to target the tumour with the microspheres attracted a lot of attention. The spherical microparticles known as microspheres are utilized in applications where a consistent and predictable particle surface area is crucial. The medication is contained in the center of the microspheres, where it is protected by a special polymeric membrane

4.4. Niosomes

Niosomes are a novel vesicular drug delivery system that can be used to deliver drugs in a targeted, controlled, and sustained manner The first vesicular drug delivery system was liposomes, however they have a number of drawbacks, including toxicity, low cost, and stability problems at varying pH. Research interest in niosomes has increased as a result of liposome drawbacks. Unilamellar, oligolamellar, and multilamellar niosomes are possible. Niosomes are non-toxic because they are composed of non-ionic surfactants, which is why they are called Niosomes [11].

4.5. Resealed erythrocyte as drug carrier

The medicine is introduced into the erythrocytes by a variety of techniques that break the cells. Afterward, the erythrocytes are sealed shut, and the resultant carriers are referred to as "resealed erythrocytes." As a medication administration method, resealed erythrocytes have a great potential to raise patient compliance and the therapeutic index. al to raise patient compliance and the therapeutic index. It offers enormous potential for achieving site-specific medication delivery with minimal drug waste and for extending the drug's release.

5. TYPES OF NOVEL DRUG DELIVERY SYSTEM

5.1 Phytosomes

Phytosomes as Drug Carriers Red blood cells (RBCs), also known as erythrocytes, have received a lot of attention and have been researched for possible medication delivery capabilities and drug loaded microspheres. These erythrocytes are known as "resealed erythrocytes" because they are made by taking blood samples from the target organisms [12]

5.2 Liposome

Liposomes are compact bilayer vesicles that contain an entirely enclosed aqueous volume, formed by a lipid membrane bilayer primarily composed of natural or synthetic phospholipids. The term 'liposome' is derived from two Greek words: 'Lipos,' meaning fat, and 'Soma,' meaning body. A wide array of medications can be encapsulated within liposomes, either within the phospholipid bilayer, depending on their lipophilicity, or at the interface of the two layers [13].

5.3 Niosomes

They are lamellar microscopic structures that are formed by a non-ionic surfactant, cholesterol admixture and a charge inducer with subsequent hydration in an aqueous environment

5.4 Nanoparticles

There are many proposed structures, assembly architectures and particle systems, the unifying feature of which is the nanometer size range (from a few to 250 nm) [14].

5.5 Nanoemulsion

Nanoemulsions can be defined as oil-in-water (o/w) emulsions with average droplet diameters ranging from 50 to 1000 nm. Typically, the average droplet size is between 100 and 500 nm. Particles can exist in "water-in-oil" and "oil-in-water" forms, and the core of the particle is either water or oil. The terms submicron emulsion (SME) and miniemulsion are used interchangeably [15].

5.6 Microcapsules

The poor solubility of many anticancer agents (such as paclitaxel, PCT; camptothecin, CPT; and certain porphyries such as mesotetraphenylporphine, TPP, used in photodynamic therapy, PDT) hinders their application and complicates direct parenteral administration.

5.7 Microemulsion

Microemulsions are liquid dispersions of water and oil that are homogeneous, transparent or translucent, and thermodynamically stable by the addition of relatively large amounts of surfactant and cosurfactant and having droplet diameters in the range of 10–100 nm. Microemulsions have been widely studied for drug targeting to the brain and for increasing the bioavailability of poorly soluble drugs. In such cases, they offer a cost-effective approach [16].

5.8 Microspheres

Microspheres are an example of a drug delivery system that has been widely evaluated in cancer chemotherapy. They are basically solid porous particles (with a diameter of 1-100 μm) that can both target their drug load by physical capture in blood vessels (chemoembolization) and maintain the effect of the therapeutic agent through controlled-release polymeric materials, including proteins, polysaccharides, polyesters and lipids by a number of different techniques (emulsification, thermal stabilization and phase inversion technology) [17].

5.9 Transdermal Drug Delivery System

Transdermal medication delivery is the application of self-contained, discrete dosage forms to intact skin in order to administer drugs to the bloodstream at a controlled rate. An essential component of new drug delivery systems, the transdermal drug delivery system (TDDS) has become well -established. The transdermal route is an intriguing choice for delivery because it is practical and secure.

The advantages of administering medications through the Skin to produce systemic effects include: Avoiding first Pass metabolism Preventing gastro intestinal compatibility issues Predictable action with a long duration

5.10 Mucoadhesive drug delivery systems

The situation in which two materials, at least one of which is Biological in nature, are kept together for a long time by Interfacial forces is known as bioadhesion. In the field of Pharmaceutical sciences, the phenomenon is known as Mucoadhesion when the sticky connection is to mucus or a Mucous membrane [18].

5.11 Osmotically controlled drug delivery systems

These systems use osmotic pressure as their driving force in Order to deliver the medicine in a regulated manner. The most Intriguing and well-liked method of drug delivery among all the available technologies is osmotic [19].

6. ADVANTAGES OF NOVEL DRUG DELIVERY SYSTEM (NDDS)

1. Protects drugs from physical and chemical degradation.
2. Maintains drug quality and stability for longer time.
3. Provides sustained and controlled drug release.
4. Improves tissue and macrophage distribution.
5. Enhances pharmacological activity through better absorption.
6. Reduces toxicity by targeted drug delivery.
7. Increases bioavailability and therapeutic effectiveness.

7. DISADVANTAGES OF NOVEL DRUG DELIVERY SYSTEM (NDDS)

1. In current therapy inactivation by gastric juice metabolism before reaching target cell- First pass metabolism in lung / liver / Intestine.
2. Too many adverse reactions, Amount of drug deliver, repeated dosage is necessary.
3. Less patient's compliance, dependency on patient's inspiratory flow rate and profile.
4. More expensive than pressurized metered dose inhalers. Low solubility [21].

8. APPLICATIONS OF NOVEL DRUG DELIVERY SYSTEM (NDDS)

8.1. Targeted Drug Delivery
8.2. Controlled releage
8.3. Personalized Medicine
8.4. Chronic Disease Management
8.5. Combination Therapies:
8.6. Gene and Cell Therapies:

9. CONCLUSION

A Novel Drug Delivery System (NDDS) combines cutting edge methods with recently created dosage forms that outperform traditional dosage forms by a significant margin. The following are benefits of the novel drug delivery system: optimal dosage at the proper time and place; efficient use of costly medications and excipients; lower manufacturing costs; benefits to patients; better therapy; and enhanced comfort and level of living. The following are benefits of the novel drug delivery system: optimal dosage at the proper time and place; efficient use of costly medications and excipients; lower manufacturing costs; benefits to patients; better therapy; and enhanced comfort and level of living.

10. AUTHOR CONTRIBUTIONS

All authors are contributed equally.

11. FINANCIAL SUPPORT

None

12. DECLARATION COMPETING INTEREST

The authors have no conflicts of interest to declare.

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