World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 6.129

NOVEL DRUG DELIVERY SYSTEM: AN ADVANCE APPROACH OF DRUG DELIVERY

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Article Received on 20/12/2023 **Article Revised on 10/01/2024** **Article Accepted on 30/01/2024**

ABSTRACT
The term "novel drug delivery system" (NDDS) describes methods, compositions, apparatus, and systems for delivering a medicinal substance throughout the body as required to safely provide the intended therapeutic effects. The Novel Drug Delivery System (NDDS) combines advanced techniques with a standard drug delivery system to administer drugs in a different way. Compared to traditional dose forms, NDDS are a considerably superior new dosage form. The development of an existing therapeutic molecule from a traditional form to a unique delivery method can greatly increase its performance in terms of patient conformity, safety, and effectiveness. Different strategies, such as medical equipment or drug equipment combination products, are used in novel drug delivery systems. Developing such delivery methods is primarily done to reduce medication loss and degradation, avoid negative side effects, and boost bioavailability. Novel medication delivery methods are devised based on biological and physical principles. The controlled drug delivery system or physical mechanism encompasses the processes of erosion, diffusion, osmosis, and dissolution. Gene therapy, liposomes, nanoparticles, and monoclonal antibodies are examples of biochemical mechanisms.

KEYWORDS: Liposomes, Niosomes, Transfersome, Nanoparticles, Ethosomes.

INTRODUCTION

The efficacy of a medication can be significantly impacted by the way it is administered. Certain medications have an ideal concentration range where the most therapeutic benefit may be obtained; dosages above or below this range may be hazardous or have no effect at all. Conversely, the sluggish advancement in the effectiveness of treating severe illnesses has indicated an increasing demand for a multidisciplinary strategy in delivering medicines to targets within tissues. This led to the development of novel concepts for managing the pharmacokinetics, pharmacodynamics, non-specific toxicity, immunogenicity, biorecognition, and effectiveness of pharmaceuticals. These innovative techniques, which go by the name "drug delivery systems" (DDS), are founded on multidisciplinary methods that bring together molecular biology, pharmaceutics, polymer science, and bioconjugate chemistry. Different drug delivery and drug targeting systems are now being developed in order to reduce drug degradation and loss, avoid negative side effects, boost medication bioavailability, and raise the proportion of the drug accumulated in the necessary zone. Once only a pipe dream or, at most, a potential, controlled and novel

drug delivery is now a reality. In this area of medication research, experts from the pharmaceutical industry as well as other fields have conducted in-depth studies during the past fifteen years.[1]

The procedure of giving a medication or pharmaceutical product to provide the intended therapeutic effect is known as drug delivery. The way a medicine is administered matters since it greatly influences how effective it is. Various strategies, such as medical devices or medication-device combo products, are used in novel drug delivery systems. A novel drug delivery system (NDDS) integrates molecular biology, pharmaceutics, and polymer science.[2–5] Certain medications have an ideal concentration range where the most therapeutic benefit may be obtained; dosages above or below this range may be hazardous or have no effect at all. Conversely, the sluggish advancement in the effectiveness of treating severe illnesses has indicated an increasing demand for a multidisciplinary strategy in delivering medicines to targets within tissues. This led to the development of novel concepts for managing the pharmacokinetics, pharmacodynamics, non-specific toxicity, immunogenicity, biorecognition, and effectiveness of pharmaceuticals. These innovative techniques, which go by the name "drug delivery systems" (DDS), are founded on multidisciplinary methods that bring together molecular biology, pharmaceutics, polymer science, and bioconjugate chemistry. Different drug delivery and drug targeting systems are now being developed in order to reduce drug degradation and loss, avoid negative side effects, boost medication bioavailability, and raise the proportion of the drug accumulated in the necessary zone.[2]

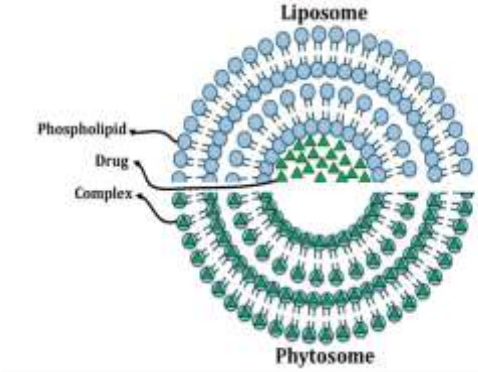
Two types of novel drug delivery systems are those that rely on biological or physical principles. Physical methods such as osmosis, diffusion, erosion, dissolution, and electrotransport are also known as controlled drug delivery systems. Monoclonal antibodies, gene therapy, vector systems, polymer drug adducts, and liposomes are examples of biochemical methods. Certain novel drug delivery methods provide therapeutic advantages such as extending the medication's duration of action, lowering dosing frequency, regulating the location of release, and preserving steady drug levels.[6–10] Among the drug carriers are soluble polymers, cells, cell ghosts, lipoproteins, liposomes, microcapsules, and microparticles composed of insoluble or biodegradable natural and synthetic polymers.

Novel medication delivery methods provide the following benefits over traditional drug administration:[11–14]

1. The blood system's or a tissue's optimal therapeutic medication concentration can be sustained for an extended amount of time.
2. A predetermined drug rate that prolongs the duration of the medication's activity.
3. The drug's short half-life might be extended.
4. By focusing on the place of action, adverse effects might be reduced.
5. Less medication waste and frequent dosage may be possible.
6. Increased adherence from patients.

A. Phytosome

Phytosomes are a vesicular delivery system for phytoelectric substances found in herbal extracts and lipid-binding (one molecular phyto-constituent bonded to at least one molecular phospholipid). Phytosomes prevent vital components of herbal extracts from degrading. gut bacteria that have enhanced absorption and digestive secretions offers enhanced biological, pharmacokinetic, and pharmacological properties as well as increased availability. parameters of a traditional herbal extract.[15] as well as the differences between liposomes and phytosomes.



Advantages of Phytosome

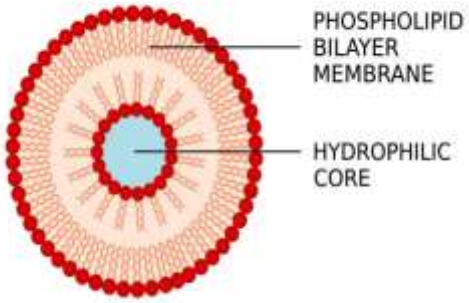
1. Enhanced bioavailability of phospholipid complexes.
2. Better absorption in the GIT.
3. Higher bioavailability is thought to contribute to better treatment outcomes.
4. Low dose is necessary due to high bioavailability.
5. More steadiness. More stability.
6. Great lipophilicity is preferred over liposomes in cosmetics due to its great penetrating properties.
7. Notable therapeutic benefits.
8. Phosphatidylcholine protects the liver rather than acting as a carrier.[16]

B. Liposomes

Lipid-filled, minuscule sacs consisting of fat molecules around a water center are extensively employed in clinical cancer therapy. Numerous varieties of liposomes are frequently used to combat infectious illnesses and are capable of delivering specific vaccinations. They encapsulate medications during cancer therapy, protecting healthy cells from their toxicity and preventing their accumulation in delicate tissues like the kidneys and liver of the patient. Moreover, liposomes can lessen or completely eradicate several typical adverse effects of cancer treatment, such nausea and hair loss. These are vesicles made up of one, many, or a lot of phospholipid bilayers. Polar medication molecules can be encapsulated thanks to the polar nature of the

liposomal core. Depending on how amphiphilic and lipophilic chemicals bind to phospholipids, they become soluble inside the phospholipid bilayer.[17]

Liposome s are hydrophobic membrane-enclosed, lipodial vesicles that carry chemicals to a specific location. The lipid bilayer of liposomes can fuse with other bilayers, such the cell membrane, to carry drugs to the intended spot.[18–21] There are several liposomal medications that have received clinical approval, including liposomal doxorubicin, liposomal amphotericin B, and liposomal cytarabine.

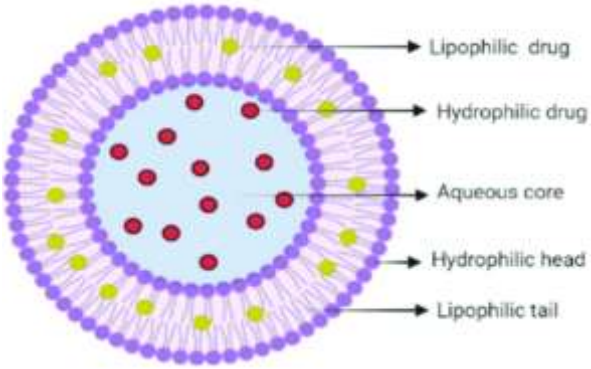


Advantages of Lipsomes

1. Liposomes may be administered systemically or non-systemically and are non-toxic, biocompatible, biodegradable, and nonimmunogenic.
2. Actinomycin's therapeutic index and effectiveness can be raised by encapsulating it in liposomes.
3. The ability of liposomes to connect with ligands unique to particular sites allows for active targeting.
4. Anti-inflammatory and anti-cancer medications that target particular sites.
5. Has a high tissue penetration rate (insulin, corticosteroids, and anesthetics).

C. Niosomes

A unique vesicular drug delivery technology called niosomes makes it possible to distribute medications in a focused, regulated, and long-lasting way. Liposomes were the first vesicular drug delivery technology, however they have a lot of disadvantages, such as toxicity, cheap cost, and pH stability issues. The disadvantages of liposomes have raised interest in niosome research. It is feasible to form unilamellar, oligolamellar, and multilamellar niosomes. The reason niosomes are non-toxic is that they are made of non-ionic surfactants, which is how they got their name. In addition to nonionic surfactants, they could also contain charged molecules and cholesterol or its derivatives. The charged molecule in the cholesterol, which gives the structure stiffness, keeps the preparation stable. Niosomes are created when non-ionic surface-active chemicals self-assemble. Because of their structure, they may be utilized to load and distribute both hydrophilic and hydrophobic medicines.[22]

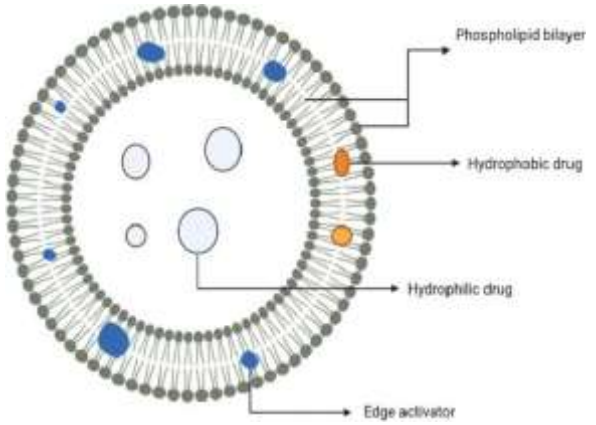


Advantages of niosomes[23]

1. To control drug delivery rate and provide normal vesicle in external non-aqueous medium, niosomal dispersion in an aqueous phase can be emulsified in a non-aqueous phase.
2. They boost the stability of the medication that is entrapped and are both osmotically active and stable.
3. They increase the epidermal penetration of medications and increase the oral bioavailability of poorly absorbed medications.
4. They can be used topically, parenterally, or orally to reach the site of action.
5. The surfactants may be employed safely in the niosome production process since they are biodegradable, biocompatible, and non-immunogenic.

D. Transfersome

In 1991, Gregor Cevc presented the concept and definition of transfersome. The Latin word "transferre," which means "to carry," is the source of the title. It is combined with the Greek word "body," "soma" fora, to signify "to transport." An artificial carrier is a translator. A vesicle that resembles the cell's typical vesicle. As such, it is appropriate for controlled and focused medication delivery. Transfersome is a highly adaptive and stress-responsive dynamic aggregate. It is a pliable vesicle encircled by the intricate Fat bilayer and featuring an aqueous core. The bilayer's shape and local composition determine the vesicle.both self-control and self-improvement. This enables the client to function as a non-intrusive target drug transport agent after successfully navigating several convey hurdles.supplying medicinal substances and ensuring their ongoing release. These parts that have self-optimized. The very flexible membrane can consistently feed a medicine through or into it. Depending on the application or administration method chosen, the skin has a high quality. These transfers are particularly suited for skin penetration since they are many orders of magnitude more elastic than standard liposomes. Squeezing them through the stratum corneum's internal lipid causes the transfers, which hinder skin penetration. The adaptability of the transfersoma membrane is attained with the proper combination of surfactive components.[24–30]



Advantage of transferosomes[25]

1. They have a high capture efficiency of around 90% in the case of lipophilic medication.
2. This high deformity increases the penetration of the intact vesicles.
3. Because transfers have a combined hydrophobic and hydrophilic infrastructure, a broad range of soluble drug molecules
4. They release its contents gradually and steadily, much like a storehouse.

E. Nanoparticles

Nanoparticles can be either amorphous or crystalline, and they are in the solid form. This includes nanospheres and nanocapsules with sizes between 10 and 200 nm. They can encapsulate and/or adsorb a medication, shielding it from enzymatic and chemical deterioration.[31–36] Biodegradable polymeric nanoparticles have garnered significant interest as possible drug delivery agents in recent times due to their potential uses in controlled drug release, targeting specific organs or tissues, acting as DNA carriers in gene therapy, and delivering proteins, peptides, and genes via the peroral route.[37,38]

Classification of nanomaterials

a) Nanotubes

They comprise carbon atom-based hollow cylinders. Additionally, they can be formed into test tubes or possible medication delivery devices by filling and sealing them.

b) Nano wires

A single human hair strand is encircled by glowing silica micro wire. It appears fragile. It is around five times more compact than a virus. Early detection of ovarian and breast cancers is one of the uses for nanowires.

c) Nanoshells

Gold-coated hollow silica spheres are known as nanoshells. The ability to affix antibodies to the surfaces of these shells allows scientists to target certain shells, like cancer cells. One day, drug-containing polymers will likewise be contained in nanoshells.

d) Nano pores

Applications for cancer research and therapy include nanopores. These pores, which are engineered into particles, are so small that individual strands of DNA may flow through them, enabling incredibly accurate and effective DNA sequencing. medication producers may also utilize nanopores to regulate the pace of medication diffusion in the body by designing them onto the surface of drug capsules at a size that is only slightly bigger than the molecules in the medicine.

e) Gold nanoparticles

These nanoparticles contain a solid core, as shown in the transmission electron microscopy image. North Western University researchers are developing very sensitive detection techniques for DNA and protein markers linked to a variety of cancer types, including breast and prostate cancer, by using gold particles.

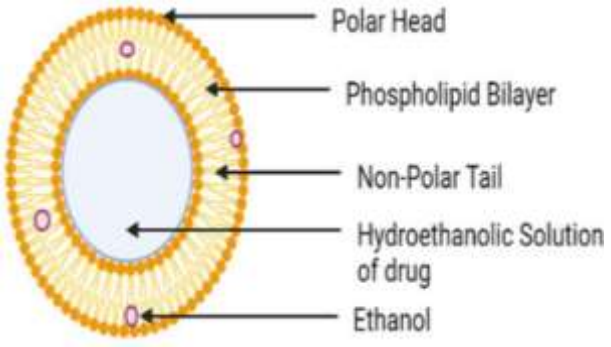
Advantages of nanoparticles[39]

The following are some benefits of using nanoparticles as a medication delivery system:

1) After parenteral injection, it is simple to modify the size and surface properties of nanoparticles to accomplish both passive and active medication targeting.
2) They manage and maintain the drug's release throughout transportation and at the location of localization, modifying the drug's distribution throughout the body and its eventual elimination to enhance therapeutic efficacy and minimize negative effects.
3) Targeting particular sites can be accomplished by the use of magnetic guiding or by affixing targeting ligands to particle surfaces.
4) The system may be administered through a variety of methods, including as intraocular, parenteral, nasal, and oral.

F. Ethosomes

A somewhat different kind of the drug conveyor liposome is called an ethosome. Ethosomes are phospholipid carriers with high ethanol contents (20–45%), which increase a drug's capacity to pass through the skin by causing the lipids in the skin to become more fluid.[40] Ethanol, phospholipids, and water are the main ingredients of ethosomes, which improve the absorption of several medications into the skin. It increases blood circulation and increases the amount of medication that reaches the deeper layers of skin. The size range of etherosomes can range from nanometers to microns. Depending on the demands of the patient, ethosomes can provide drugs in the form of gel or cream.



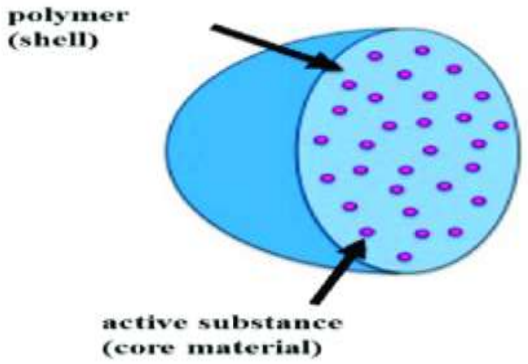
Advantages of ethosome[41]

1. It improves medication distribution via the skin by causing the lipids in the skin to become more fluid.
2. The pharmaceutical, veterinary, and cosmetic fields are the main industries that employ ethosomal drug delivery systems.
3. It improves the medication molecule's therapeutic impact and efficacy.
4. The semisolid shape of the ethosomal drug delivery technology leads to increased patient compliance.
5. It lessens the encapsulated agent's toxicity.

G. Microsphere

A microsphere is made up of tiny, spherical particles with dimensions ranging from one to a thousand micrometers. Microparticles are another name for microspheres. Materials that are synthetic or natural can be used to create microspheres. There are several kinds of microspheres accessible, including micrometrics and microcapsules.

Microcapsules are those in which the unique capsule wall precisely encloses the material that has been caught. Micrometrics are those where the material that has been caught is distributing over the microsphere matrix.[42] Both oral and injectable administration options are available for these microspheres. A microsphere drug delivery device can improve the therapeutic efficacy of the medication and get around some of the problems with traditional treatment.[43]

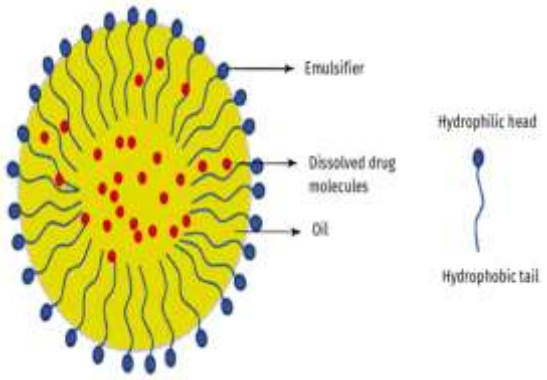


Advantages of Microsphere

1. The medication may be readily released from the formulation by using the microsphere drug delivery technology.
2. It enhances the formulation's medicinal effectiveness.[44]
3. The microsphere improves patient compliance by reducing the frequency of medicine dosages.[45]
4. It may be applied to the delivery of drugs to specified organs and sites.[46,47]

H. Nano-emulsion

The purpose of nano-emulsion is to enhance the delivery of active medicinal components through nanoscale emulsion. Nanoemulsion droplet sizes generally vary from 20 to 200 nm. As a drug delivery method, the solid spherical carrier's amorphous, lypophilic, negatively charged surface maximizes the therapeutic effectiveness of the medication while reducing any unfavorable deleterious effects. Biphasic dispersions of two immiscible liquids, such as water in oil or oil in water droplets stabilized by an amphoteric surfactant, are known as nano-emulsions.[48]



Advantaged of Nano-emulsion[49-54]

1. Drugs' cutaneous and transdermal efficaciousness may be enhanced by nano-emulsions.
2. A lot of people believe that nano-emulsions will be effective drug delivery vehicles for the targeted administration of lipophilic cytotoxic antineoplastic drugs in cancer treatments.
3. When compared to normal gentamycin, rats given a nano-emulsion formulation of eucalyptus essential oil showed enhanced wound healing activity.
4. Antitubercular medication nanoemulsions increase drug absorption by facilitating the easy passage of biological barriers to the systemic Mycobacterium TB infection.
5. Although fortified foods and sun exposure can produce vitamin D, which is known to be insufficient for a variety of skeletal and nonskeletal processes, vitamin D deficiency is a global issue. The use of nano-emulsion delivery systems has promise for increasing vitamin D bioavailability.

CONCLUSION

The innovative dosage forms in NDDS combine modern technology with superiority over conventional dosage forms. The innovative drug delivery system offers advantages to patients, better therapy, reduced manufacturing costs, efficient use of expensive pharmaceuticals and excipients, ideal dose at the right time and location, improved comfort and quality of life, and benefits to patients. Among the fundamental novel drug delivery system modalities are targeted and controlled drug delivery systems, among others. Pharmaceutical science focuses on the administration of medications, vaccinations, gene therapy, and the commercial development of new carriers, among other innovative methods for drug transport and targeting.

CONFLICT OF INTEREST

The authors declare that the review was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

ACKNOWLEDGEMENT

The authors are thankful to their institutes.

FUNDING

None.

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