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Research Article

**IMPORTANCE OF NOVEL DRUG DELIVERY SYSTEM IN
HERBAL MEDICINES**¹Bhagyashree R. Kundalwal, ²Nikita R. Dhakne, ³Shubham S. Shankar, ⁴Shubhangi M. Sonsale, ⁵Pooja N. Pitale, ⁶Mr.Vaibhav G. Kute*, ⁷Dr.Vitthal G. Kuchake

Students, SSJP's, Ojas College Of Pharmacy, Revgaon road, Rohanwadi, Jalna, Maharashtra-431203, India.

Article Received: September 2022**Accepted:** October 2022**Published:** November 2022**Abstract:**

The performance of an existing medicinal molecule in terms of patient compliance, safety, and efficacy can be greatly enhanced by evolving it from a traditional form to a unique delivery mechanism. An old medication molecule can be given new life as a Novel Drug Delivery System. A significant improvement in the ability to release a drug at a specified spot and rate is possible with a novel drug delivery system that is properly developed. Pharmaceutical companies are working to create novel drug delivery systems in order to give medications to patients effectively and with fewer side effects. This article discusses the fundamentals of novel drug delivery systems as well as their various varieties.

Keywords: Patient Compliance, Traditional, Novel Drug Delivery System, Medication, Herbal medicines.

Corresponding author:**Mr. Vaibhav GhanshamKute,**

Assistant Professor, Department of Pharmaceutics

SSJP's, Ojas College Of Pharmacy,

Revgaon road, Rohanwadi, Jalna, Maharashtra-431203, India.

Email id: vaigkute@gmail.com

QR code



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INTRODUCTION:

A novel drug delivery system is a new system that offers a more logical approach to the creation of an ideal drug delivery system by advancing our understanding of the pharmacokinetics and pharmacodynamics behaviour of the drug[1]. The future of medicine is anchored in the past, before scientists set out to create artificial panaceas for every ailment, and before pharmaceutical companies tethered our collective well-being to what has grown into a multibillion-dollar business for them[2]. The efficacy of a medicine can be significantly impacted by the way it is administered. Some medications have an ideal concentration range where the greatest benefit is obtained; dosages outside or inside of this range can be hazardous or have no therapeutic effect at all[3].

The drugs are produced in an appropriate formulation that takes into account the safety, acceptability, and efficacy of other substances. This preparation is frequently referred to as a dosage form or drug delivery system. The dosage form has evolved from simple mixtures and pills to highly sophisticated technologies, intensive drug delivery systems, or NDDSs, with the advancement in all fields of science and engineering[4].

Novel drug delivery system is a new strategy to drug delivery. By integrating the drug into a carrier system or by altering the drug's molecular structure, the distribution of the drug can be controlled to act longer and more effectively[5].

Advantages of Novel Drug Delivery System

1. Defence against chemical and physical deterioration.
2. Consistent delivery.
3. More evenly distributed tissue macrophages.
4. Improvement in stability
5. Increasing the pharmacological activity.
6. Safety from toxic substances.
7. An improvement in bioavailability
8. Increasing solubility[5].

Herbal Medicines

Natural substances derived from plants called "herbal medicines" are used to treat illness in traditional local

or regional medicine systems. The complex mixture of organic compounds that make up these products might originate from any unprocessed or processed component of a plant[6].

Advantage of herbal drugs

1. Low risk of side effects: Compared to conventional medicine, herbal drugs are typically well tolerated by patients, have fewer unintended consequences and side effects, and may even be safer to use.
2. Greater Effectiveness: Herbal medications are more successful for persistent health issues that don't improve with conventional treatment. The use of herbs and complementary therapies to treat arthritis is one instance. On the other hand, arthritic herbal therapies have less adverse effects. These treatments involve dietary adjustments like introducing simple herbs, avoiding vegetables from the nightshade family, and consuming less white sugar.
3. Lower cost: Herbal medicines are substantially less expensive than prescription drugs. The price of prescription medication is significantly increased by research, testing, and marketing. Compared to medicines, herbs are typically more affordable.
4. Widespread accessibility: Herbs are sold over-the-counter. You may grow simple herbs at home, such chamomile and peppermint[7].

Herbal products are considered as a potential candidate for delivery through the novel delivery system because of the following properties:

1. Compared to many other medications or surgical procedures, several natural chemicals have been demonstrated to deliver greater benefits with fewer adverse effects.
2. They are able to deliver combinations of compounds with many functions that have potentiating and synergistic effects.
3. They differ from modern medicines in that they have a very strong experimental basis for their use but may be toxic, whereas they have a strong traditional or conceptual base and the potential to be useful as drugs in terms of safety and effectiveness[8].

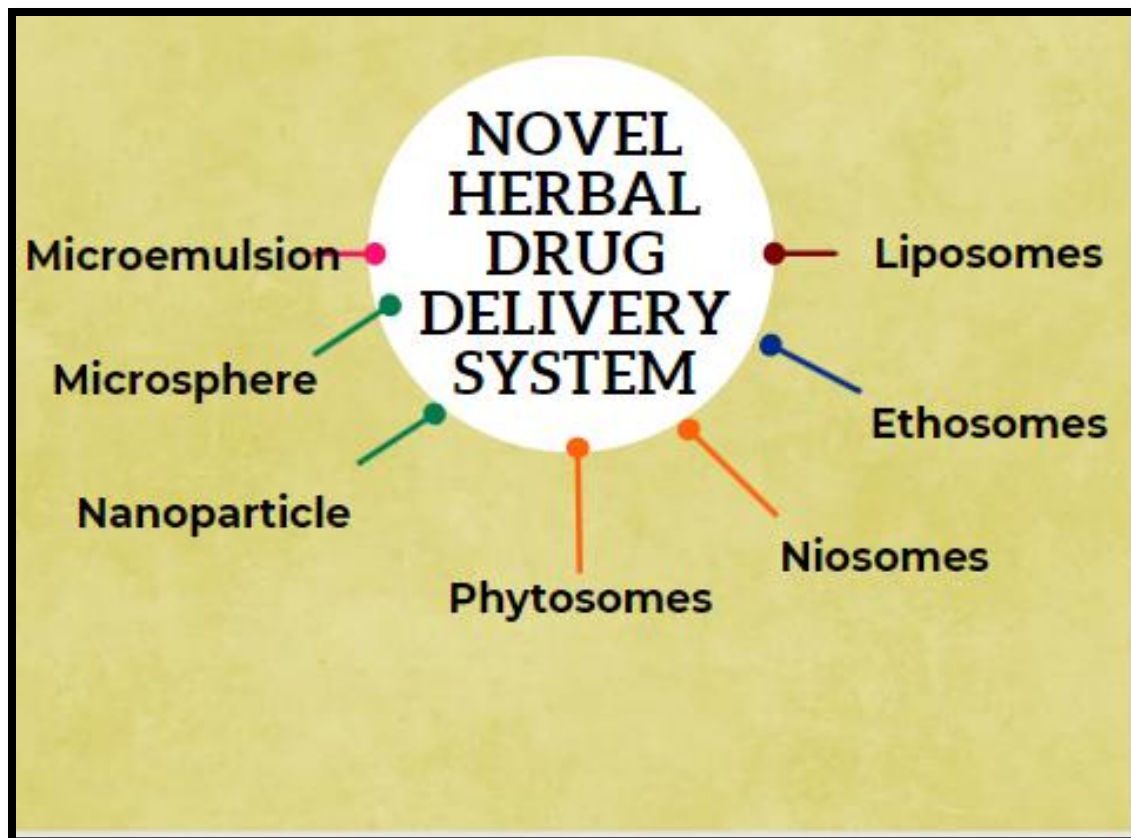
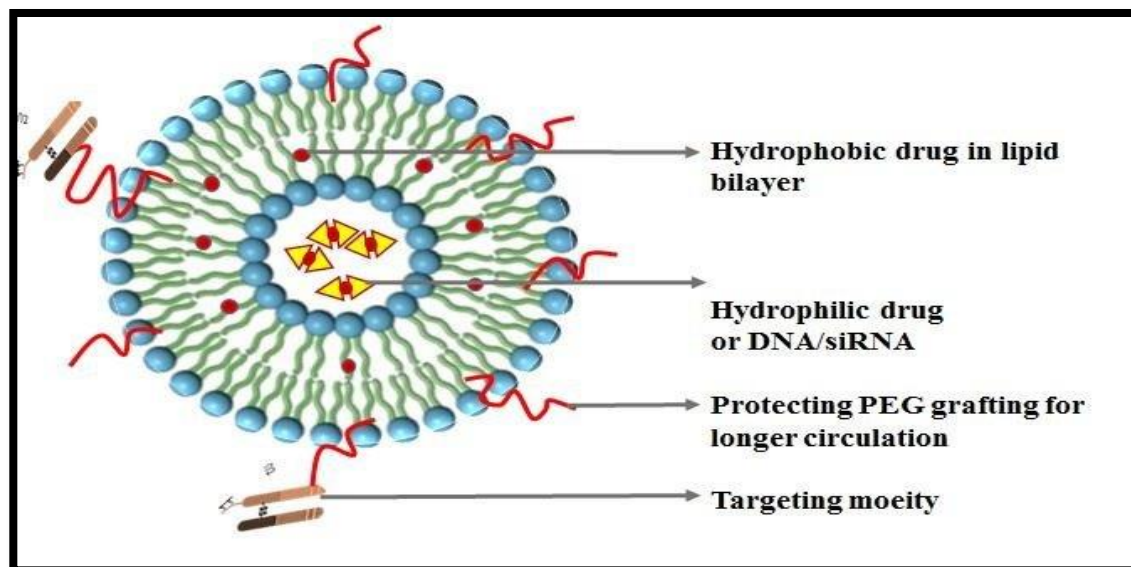


Fig.1: TYPES OF NOVEL HERBAL DRUG DELIVERY SYSTEM

LIPOSOMES

Liposomes are tiny, spherical artificial vesicles that can be made from cholesterol and safe, natural phospholipids[10]. A lipid bilayer membrane composed of phospholipids from natural or synthetic sources completely encloses an aqueous volume in liposomes, which are concentric bilayer vesicles. Lipos is Greek for fat, while Soma is for body[9]. Drugs that are both hydrophobic and hydrophilic can be trapped inside liposomes due to



their size, which also prevents the medication from decomposing and allows it to be released at specific sites[10].

Advantages of Liposomes

1. Liposomes are non-toxic, fully biodegradable, biocompatible, and immunogenic.
2. Suitable for the delivery of medications that are hydrophobic, amphipathic, and hydrophilic.
3. Shield the medicine that has been encapsulated from the environment.
4. Lessened toxicity and greater stability—Liposomal encapsulation can enhance the therapeutic effectiveness of chemotherapeutic drugs. This lessens negative effects that are shown at conc. comparable to or lower than those necessary for the optimum therapeutic effect.
5. Lessens hazardous medication exposure to delicate tissues.

Disadvantages of Liposomes

1. The production of liposomes is expensive, which is a drawback.
2. Encapsulated drug/molecule leakage and fusion.
3. A brief half-life[11].

PHYTOSOMES

Many plants are referred to as phyto, while the word "some" denotes cell-like. The term "herbosomes" is sometimes used. This is a brand-new, patented process that produces lipid compatible molecular complexes by complexing standardised plant extracts or water-soluble phytoconstituents with phospholipids. This significantly increases absorption and bioavailability[12]. Phytosomes are herbal medications that have been packed inside of vesicles and are accessible in Nano form. The primary component of a herbal extract is protected from destruction by bacteria and digestive secretions thanks to the phytosomes' provision of an envelope-like covering around the active ingredient of the medication. Phytosomes can efficiently absorb from a lipid-loving environment of the cell membrane into a water-loving environment and then reach the blood circulation. The current analysis emphasises the potential applications and cutting-edge technology in NDDS for the advancement of herbal and traditional medicines made from plant sources[15].

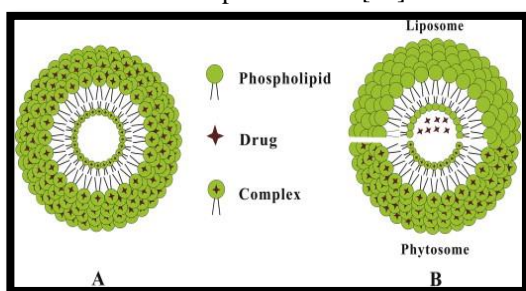


Fig.3: Phytosome[14].

Advantages of Phytosomes

1. It improves the bioavailability of lipid-insoluble polar phytoconstituents by oral as well as topical means, leading to much superior therapeutic benefit.
2. When an active ingredient's absorption is improved, its quantity requirement is also decreased.
3. The phosphatidylcholine molecule and phytoconstituent form chemical linkages, which strengthen the stability of the phytosomes.
4. Phospholipids have additional nutritional benefits.
5. Significant drug entrapment
6. Using phytoconstituents as phytosomes improves their cutaneous absorption and serves as a cosmetic ingredient[16].

Phytosome disadvantages include

1. They limit its absorption whether given topically or orally.
2. The phytosome is swiftly cleared of phytoconstituents.
3. Issues with stability[17].

ETHOSOMES

"Ethosomes are ethanolic liposomes". Ethosomes are noninvasive drug delivery systems that allow medications to penetrate deeply into the epidermal layers and/or the bloodstream. These flexible, squishy vesicles are designed for improved active agent distribution.

Alcohol (ethanol and isopropyl alcohol) and water are both present in quite high concentrations in phospholipid- and ethanol-containing lipid vesicles called ethosomes. Ethosomes are soft vesicles composed primarily of water, phospholipids, and ethanol (in larger amounts). Ethosomes range in size from tens of nanometers (nm) to microns. Ethosomes have a substantially higher transdermal flux and penetrate the skin layers more quickly[18].

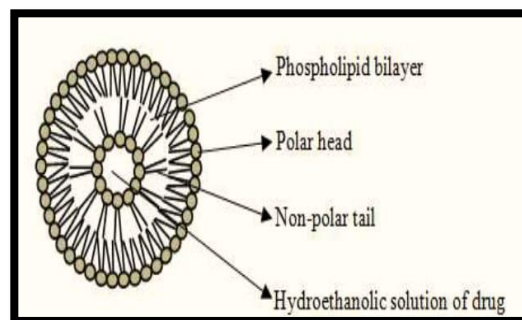


Fig.4: Ethosomes[36]

Advantages of Ethosomes

1. Ethosomes are easy to use and safe for the skin.
2. Due to their ability to be produced in semisolid dose forms (Gel or Creams) and their resistance to the drawbacks of iontophoresis and phonophoresis, ethosomes significantly improve patient compliance [19].
3. Ethosomes improve the drug's transdermal and dermal distribution through the skin.
4. Low risk profile.
5. High patient adherence rates[22].

Disadvantages of Ethosomes

1. Poor yield.
2. If shell locking is unsuccessful, the ethosomes may agglomerate and disintegrate when transferred into water.
3. Product loss when switching from organic to water media[22].
4. Expensive[19].

NANOPARTICLES

The word "nano" is a Greek word that means "dwarf" or "very little." Between 1 and 1000 nm in size, nanoparticles are solid colloidal particles made of macromolecules in which the active components have been dissolved, trapped, encapsulated, or adsorbed. The medicine is contained in nano capsules, which have an aqueous or oily core and a shell-like wall around them[20]. Nanoparticles are either amorphous or crystalline and are in the solid form[3, 21]. They are intended to adsorb and/or encapsulate a medication, shielding it from enzymatic and chemical destruction[21]. Controlling particle size, surface characteristics, and the release of pharmacologically active substances are the main objectives when designing nanoparticles as a delivery system in order to achieve the drug's site-specific activity at the therapeutically ideal pace and dosing regimen[23].

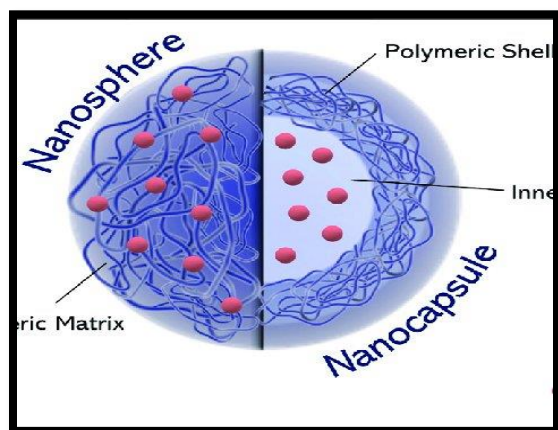


Fig.5: Nanoparticle[37]

Advantages of nanoparticles

1. Due to the ability of tiny nanoparticles to pass through smaller capillaries, effective drug accumulation at the target areas may be possible.
2. There are many other ways to provide medication, such as orally, nasally, parenterally, intravenously, etc.[24].
3. There is no medication waste, resulting in improved drug bioavailability at a particular spot.
4. More precisely directed at the troubled spot[10].

Disadvantages of nanoparticles

1. Limited shelf life
2. More costly.
3. Elimination and metabolism differ depending on the kind of material used to create the nanoparticles[25].

NIOSOMES

The name "niosomes" comes from the fact that the amphiphilic character of the niosomes encapsulates the drug in a vesicle made of a non-ionic surfactant. Niosomes are quite tiny and microscopic in size. [26] The first account of non-ionic surfactants self-assembling into vesicles was made in the 1970s by researchers in the cosmetics business. While the hydrophilic heads of the bilayer stay in contact with the aqueous solvent, the hydrophobic portions are orientated away from it. Niosomes are tiny, lamellar structures with a size range of 10 to 1000 nm[27]. While lipophilic compounds are typically trapped by partitioning into the lipophilic domain of the bilayers, hydrophobic medications are typically enclosed in the inner watery core or adsorbed on the bilayer surfaces. Niosomes are superior than liposomes and have higher surfactant chemical durability than phospholipids, which are less durable and more easily hydrolyzed because of the ester link[10].

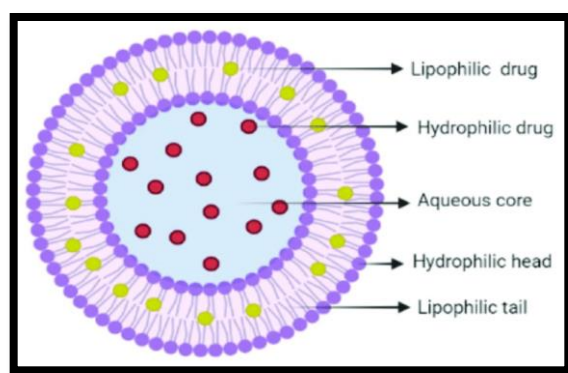


Fig.6:Niosome[39]

Advantages of Niosomes

1. Niosomes have a lengthy storage duration and are osmotically active.
2. Niosomes have low toxicity, are biodegradable, biocompatible, nonimmunogenic, and improve patient compliance.
3. Niosomes make the medicine that is entrapped more stable.
4. When administered through the transdermal route, the drug's penetration is improved.
5. They can deliver the medicine to the brain by bridging the BBB[28].

Disadvantages of Niosomes

1. Unstable physical condition.
2. Aggregation.
3. Fusion
4. Drug leakage due to clogs[29].

MICROSPHERES

Microspheres are spherical, solid particles with sizes between 1 and 1000 microns. They are spherical, freely moving particles made of artificial polymers or proteins. The microspheres are naturally occurring free-flowing powders made of biodegradable synthetic or protein-based polymers[30].

Microspheres come in two different varieties:

1. Microcapsule - Microcapsule are entrapped substances that have a characteristic capsule wall surrounding them.
2. Micrometric - Micrometrics in which the substance that is being captured is dispersing throughout the matrix of the microspheres[31].

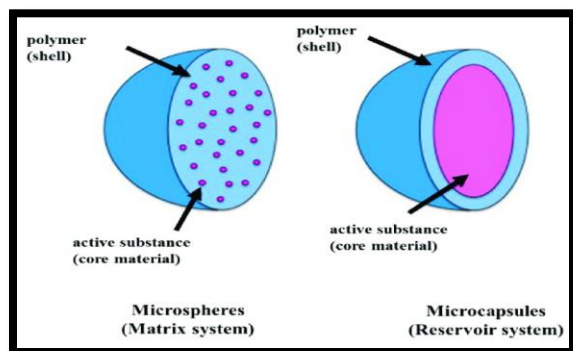


Fig.7:Microsphere[38]

Advantages of microsphere

1. A steady and sustained therapeutic impact is provided by microspheres.
2. Decreases the frequency of dose, which enhances patient compliance.
3. They could be injected into the body because of their small size and spherical shape.

4. Increase bioavailability and lessen the frequency or severity of negative effects.

Disadvantages of microsphere

1. The formulas' changed release.
2. Varying release rates from one dose to the next.
3. Crushing or chewing this type of dosage form is not advised[32].
4. Possibly hazardous[33].

MICROEMULSION

Hoar and Schulman, who created a clear single-phase solution by hexanol-trituration of a milky emulsion, first proposed the idea of a microemulsion in the 1940s. By mixing oil with an aqueous surfactant solution and adding alcohol as a co-surfactant, they created the first microemulsion, which produced a transparent, stable formulation.

A clean, transparent, thermodynamically stable dispersion of oil and water is referred to as a microemulsion, and it is stabilised by an interfacial coating of a surfactant, typically in conjunction with a co-surfactant. These systems are also referred to as swelling micelles, transparent emulsions, and solubilized oils[34].

Advantages of Microemulsion

1. Because microemulsions are thermodynamically stable systems, the system can self-emulsify.
2. A property is independent of the procedure used.
3. They have the ability to solubilize medicines that are both hydrophilic and lipophilic, including those that are largely insoluble in both aqueous and hydrophobic solvents. They are hence referred to as supersolvents.
4. Drugs that are hydrophilic or lipophilic can act as a reservoir in the dispersed phase, respectively.
5. Because of their small size, microemulsions may be filtered and sterilised.
6. Simple to prepare and requires little effort on the part of the cook.
7. Increase the drug's effectiveness.

Disadvantages of Microemulsion:-

1. Surfactant and co-surfactant concentrations must be high.
2. Limited ability to dissolve substances with high melting points.
3. A non-toxic surfactant is required for medicinal applications.

- Environmental factors like temperature and pH have an impact on the stability of microemulsions[35].

CONCLUSION:

Novel drug delivery systems serve to boost therapeutic value by decreasing toxicity, enhancing bioavailability, and other factors. They also lessen the need for repeated administration to overcome non-compliance. Herbal medicines are the subject of extensive study to include them in new drug delivery methods. Due to the large molecular size, poor solubility and GI degradation of herbal medicines. The application of these novel techniques to natural medicines will result in improved bioavailability, reduced toxicity, sustained release action and protection from GI degradation, which cannot be obtained through conventional drug delivery system.

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