



ChemTech

International Journal of ChemTech Research

CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.12 No.05, pp 39-53, 2019

Vesicular Drug Delivery System: A Review

B. Narasimha Rao*, K. Ravindra Reddy, B. Mounika,
S. Rahath Fathima, A. Tejaswini

Department of Pharmaceutics, P. Rami Reddy Memorial College of Pharmacy,
Prakruthi Nagar, Kadapa-516003, A.P., India.

Abstract : Designing of the drug in the vesicular system has brought a new life to the preexisting drugs and thus has improved their therapeutic efficacies by controlling and sustaining the action. The objective of the study is to evaluate the potential of novel vesicular drug delivery systems for drug targeting. Novel drug delivery attempts to either sustain drug action at a predetermined rate, or by maintaining a relatively constant, effective drug level in the body with concomitant minimization of undesirable side effects. A novel drug delivery system is that delivers drug at predetermined rate decided as per the requirement, pharmacological aspects, drug profile, physiological conditions of the body etc. In current conditions, not a single novel drug delivery system behaves ideally those high goals with fewer side effects. The application of vesicular system in drug delivery has changed the definition of diagnosis and treatment in different aspects of biomedical field. A Vesicular Drug Delivery System (VDDS) is the system in which encapsulation of active moieties in vesicular structure, which bridges gap between ideal and available of novel drug delivery system. A number of vesicular drug delivery systems like liposomes, niosomes, transferosomes, pharmacosomes, colloidosomes, herbosomes, sphinosomes, etc. have been developed. This review has been focusing the discussion of about various lipoidal and nonlipoidal vesicular drug targeting.

Keywords : Vesicular Drug Delivery System, Novel drug delivery, liposomes, niosomes.

Introduction:

The quest never ends. From the very beginning of human race; the quest is going on for newer and better alternatives, and in case of drugs it will continue; continue until we find a drug with maximum efficacy and no side effects. Many drugs, particularly chemotherapeutic agents have narrow therapeutic window, and their clinical use is limited and compromised by dose limiting toxic effects. Thus, the therapeutic effectiveness of the existing drugs is improved by formulating them in advantageous way ⁽¹⁾. Drug delivery refers to approaches, formulations, technologies and systems for transporting a pharmaceutical compound in the body as required to safely achieving its desired therapeutic effect, in the past few decades, considerable attention has

B. Narasimha Rao *et al* // International Journal of ChemTech Research, 2019,12(5): 39-53.

DOI= <http://dx.doi.org/10.20902/IJCTR.2019.120505>

been focused on the development of new drug delivery system (NDDS)⁽⁴⁾. The novel drug delivery system is said to be a rebirth system as it has modified a number of drugs, helped in overcoming several associated problems with these drugs, and thus got us with prolonged acting drugs with controlled action^(2, 3). In the past few decades, considerable attention has been focusing on the development of novel drug delivery system (NDDS). The NDDS should ideally fulfill two prerequisites: Firstly, it should deliver the drug at a rate directed by the needs of the body, over the period of treatment. Secondly, it should channel the active entity to the site of action⁽⁵⁾. Conventional dosage forms including prolonged released dosage forms unable to fulfill none of these desired characteristics. At present, no available drug delivery system behaves ideally but attempts have been made to bridge the gap between ideal & available⁽²⁷⁾.

There are different types of pharmaceutical carriers are present. They are particulate type carrier (lipid particles), microspheres, nanoparticles, polymeric micelles and vesicular systems (liposomes, transfersomes, pharmacosomes, ethosomes, niosomes etc.). Nowadays vesicles as a carrier system have been become the vehicle of the choice for the drug delivery and lipid vesicles were found to be of value in immunology, membrane biology and diagnostic technique and most recently in genetic engineering⁽¹⁰⁾.

Vesicular Systems:

“Vesicles have become the choice in drug delivery system called Vesicular Drug Delivery System.”

E. g: Liposomes, Niosomes, Pharmacosomes etc.⁽²⁶⁾.

The vesicular system is highly ordered assemblies of one are concentric lipid bilayer formed when certain amphiphilic building blocks are confronted with water. These biological vesicles origin was first reported in 1965 by Bingham⁽¹⁰⁾.

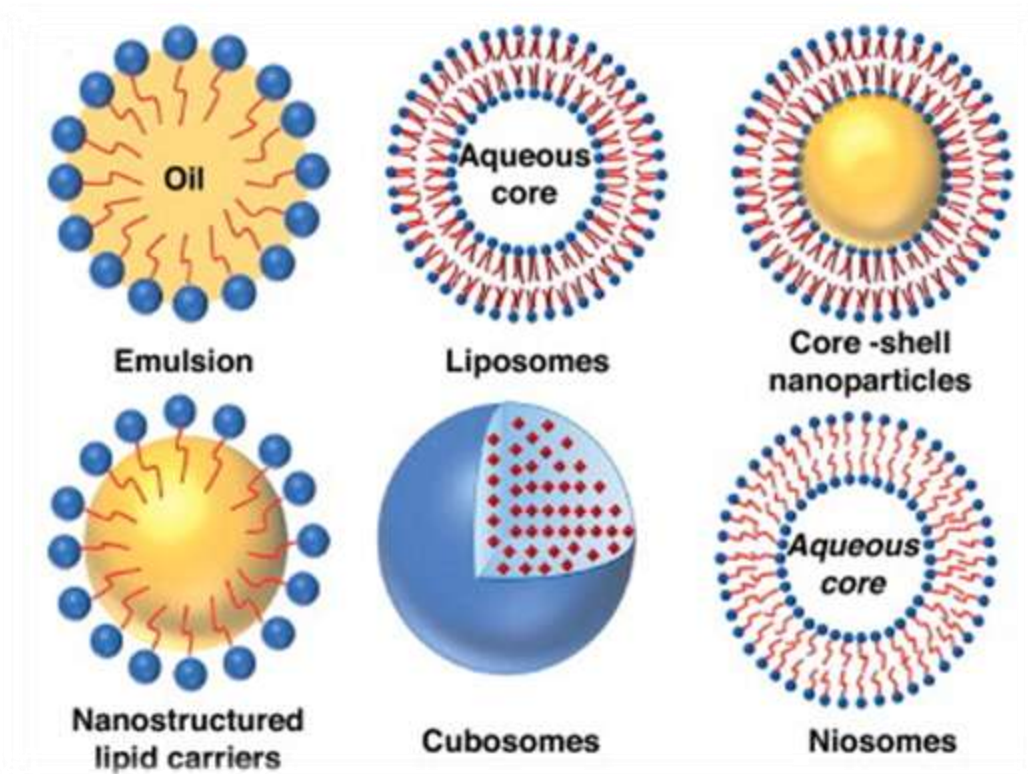


Fig-1 Types of Vesicular Drug Delivery Systems

Advantages:

- Prolong the existence of the drug in systemic circulation, and perhaps, reduces the toxicity if selective uptake can be achieved due to the delivery of drug directly to the site of action.
- Delays elimination of rapidly metabolized drugs and thus functions as sustained release systems⁽²⁾.

- Reduces the cost of therapy^(26, 28).
- Improves bioavailability.
- Hydrophilic-lipophilic drugs can be incorporated.
- Sustained release system function.
- Delayed elimination of rapidly metabolized drugs.

Disadvantages:

Along with number of advantages, VDDS has some serious disadvantages, which restrict their use. They are as follows:

- Drugs passively, which may lead to low drug loading efficiency and drug leakage in preparation, preservation and transport in vivo.
- Need of intensive sonication, leads to leakages of drug during storage⁽³⁰⁾.

Why Do We Use VDDS?

Conventional chemotherapy for treatment of intracellular infections is not effective due to limited permeation of drugs into cells. To improve bioavailability at the site of diseases reduces harmful side effects of conventional & controlled release drug delivery systems, overcome problem of degradation of drug &/ or drug dose⁽²⁹⁾.

Types of VDDS:

The targeted vesicles are classified on the basis of their composition⁽²⁵⁾

- a) Lipoidal biocarriers
- b) Non-lipoidal biocarriers

a. Lipoidal biocarriers

1. Liposomes
2. Emulsomes
3. Enzymosomes
4. Sphingosomes
5. Ethosomes
6. Transferosomes
7. Pharmacosomes

b. Non-lipoidal biocarriers:

1. Niosomes
2. Bilosomes
3. Aquasomes

LIPOSOMES:

Liposomes are simple microscopic vesicles in which lipid bilayer structures are present with an aqueous volume entirely enclosed by a membrane, composed of lipid molecule. There are a number of components present in liposomes, with phospholipids and cholesterol being the main ingredients⁽¹⁾. The stratum corneum lipid liposomes (SCLL) are vesicular systems made of lipids with a composition similar to the lipids found in the outer layer of human skin, the stratum corneum. Phospholipids are the major components but an additional surfactant acts as an edge activator to modify elasticity and increase deformability⁽²⁾.

Liposomes consist of one or more concentric lipid bilayers, which enclose an inner aqueous volume(s). For drug delivery applications liposomes are usually unilamellar and range in diameter from about 50 – 150 nm. Larger liposomes are rapidly removed from the blood circulation⁽¹⁸⁾.

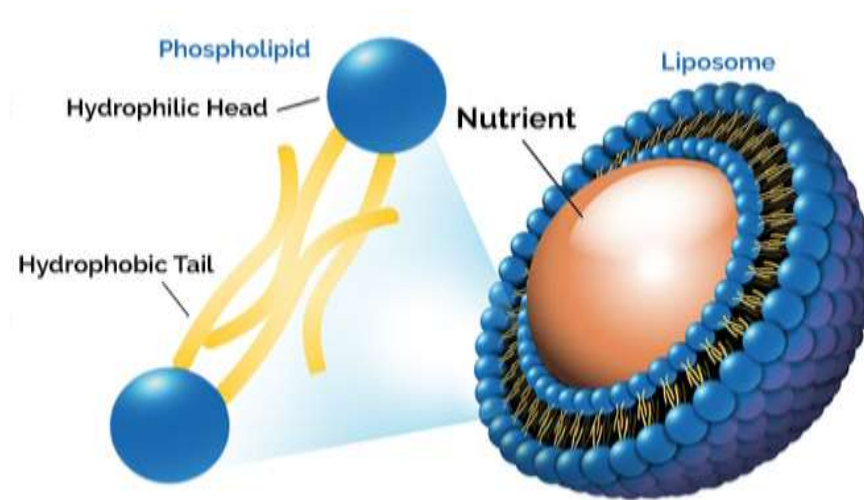


Fig-2 liposomal structure

Advantages:

Advantages of liposomes are as follows:

- Provides selective passive targeting to tumor tissues (lipoidal doxorubicin).
- Increased efficacy and therapeutic index.
- Increased stability via encapsulation.
- Reduction in toxicity of the encapsulated agent.
- Site avoidance effect ⁽¹⁹⁾.
- Improved pharmacokinetic effects (reduced elimination, increased circulation life times).
- Flexibility to couple with site specific ligands to achieve active targeting.
- Liposome is used for drug delivery systems due to its unique structural properties.
- Liposome can carry both the hydrophobic and hydrophilic drug. Therefore, liposomes as a drug carrier can indiscriminately deliver drugs through the cell membrane ⁽²²⁾.
- Liposomes herbal therapy acts as a carrier for small cytotoxic molecules and as vehicle for macromolecules as gene.
- Liposome formulation can produce sustained and controlled release of formulation and enhances the drug solubility⁽²¹⁾.

Disadvantages:

- High production cost.
- Leakage and fusion of encapsulated drug/ molecules.
- Phospholipids undergo oxidation.
- Hydrolysis like reaction.
- Short half-life⁽⁹⁾.

Classification:

1. Classification according to size:

MLV	Multilamellar Large Vesicles – >0.5µm
OLV	Oligolamellar vesicles -0.1- 1µm
UV	Unilamellar Vesicles (all size ranges)
SUV	Small Unilamellar Vesicles – 20-100nm
MUV	Medium sized Unilamellar Vesicles
LUV	Large Unilamellar Vesicles - >100
GUV	Giant Unilamellar Vesicles - >1µm

2. Classification according to methods of preparation:

1. Extraction method: VET (Vesicles prepared by Extraction method)
2. French Press Cell method
3. Fusion method
4. IV Reverse phase Evaporation method: SUVs, MLVs & OLVs
5. Frozen and Thawed multilayered vesicles
6. Dehydration & rehydration method: DRV
7. Stable Plurilamellar air vesicles method: SPLV

3. Based on In-Vivo applications:

1. Conventional liposomes
2. Long circulatory liposomes
3. Immunoliposomes
4. Cationic liposomes
5. Fusogenic liposomes⁽⁹⁾

Preparative methods of liposomes:

All methods of liposomes involve dissolution of cholesterol, lecithin, and charge in organic solvent, followed by drying it to a thin film and then dispersion of film in an aqueous medium to obtain liposome suspension at a critical hydrating temperature.

General steps involved in the preparation of Liposomes are⁽⁹⁾:

1. Preparation of lipids for Hydration
2. Hydration of lipid film/cake
3. Sizing of lipid suspension
 - i. Sonication
 - ii. Extraction

All the methods of preparing liposomes involve four basic stages⁽³¹⁾:

1. Drying down lipids from organic solvent.
2. Dispersion of lipid in aqueous media.
3. Purification of resultant liposome.
4. Analysis of final product.

The methods of preparation have been classified to the three basic modes of dispersion:

- Physical dispersion involving hand shaking and non-hand shaking methods.
- Solvent dispersion involving ethanol injection, ether injection, double emulsion vesicle method, reversesphase evaporation method, and stable plurilamellar.
- Detergent solubilization.

Structural components of liposomes:

Various lipids and amphiphiles are available as liposomes raw materials or additives that are required for the formation of lipid bilayers. Phospholipids, Synthetic phospholipids, Glycerolipids, Sphingolipids, Glycosphingolipids, Steroids, Polymeric material, Charge inducing lipids⁽⁹⁾.

- Phospholipids
 - Natural phospholipids

Phosphotidylcholine
Phosphotidylserine
Phosphotidylethanolamine

Phosphatidylinositol

- Synthetic phospholipids

Dioleoyl-Sn-Glycero-3-[Phospho-L-Serine (Sodium Salt)] (DOPS)

Distearoylphosphatidylcholine (DSPC)

Dipalmitoylphosphatidylserine (DPPS)

- Sphingolipids

Sphingomyelin

- Glycosphingolipids

Gangliosides

- Steroids

Cholesterol

- Polymeric material

Lipids conjugate to dine,

Methacrylate,

Thiol group

- Charge-inducing lipids

Diocetyltrimethyl ammonium bromide/chloride (DODAB/C)

Dioleoyltrimethyl ammonium propane (POTAP)

- Other substances

Stearylamine&Dicetylphosphates

Polyglycerol&polyethoxylated mono &dialkylamphiphiles

Applications of Liposomes:

- ❖ Liposomes as drug/protein delivery vehicles, controlled and sustained drug release, enhanced drug stabilization, altered pharmacokinetics and biodistribution, enzyme replacement therapy and biodistribution, enzyme replacement therapy and lysosomal storage disorders
- ❖ Liposomes in antimicrobial, antifungal and antiviral therapy, Liposomal drugs, Liposomal biological response modifiers
- ❖ Liposome in tumor therapy: Carrier of small cytotoxic molecules, Vehicles for macromolecules as cytokines or genes
- ❖ Liposomes in gene delivery: Gene and Antisense therapy, Genetic (DNA) vaccination.
- ❖ Liposomes as artificial blood surrogates
- ❖ Liposomes as radiopharmaceutical and radio diagnostic carriers
- ❖ Liposomes in cosmetics and dermatology
- ❖ Liposomes in enzyme immobilization and bioreactor technology⁽³²⁾

Niosomes:

Niosomes are non-ionic surfactants vesicles obtained on hydration of synthetic non-ionic surfactants with or without incorporation of cholesterol or lipids⁽¹⁰⁾. Niosomes are formations of vesicles by hydrating mixture of cholesterol and non ionic surfactants. These are formed by selfassembly of nonionic surfactant in non-aqueous media as spherical, multilamellar system and polyhedral structure in addition to inverse structures which appears only in on aqueous solvent⁽¹²⁾. Since then a number of nonionic surfactants have been used to

prepare vesicles. e. g., Polyglycerol alkyl ethers, glucosyldialkyl ethers, crown ethers, polyoxyethylene alkyl ethers, ester linked surfactants, steroid linked surfactants, brij and a series of spans and tweens⁽¹⁾. They are vesicular systems similar to liposomes that can be used as carriers of amphiphilic and lipophilic drugs. The vesicles are defined to be composed of or relating to small, sac like bodies. Niosomes and liposomes are equiaactive in drug delivery potential and both increase efficacy as compared with that of free drug. Niosomes are preferred over liposomes because the former exhibit high chemical stability and economy⁽²⁾. Niosomes or nonionic surfactant vesicles are microscopic lamellar structure of size range 10-1000nm consisting of spherical, uni or multilamellar and polyhedral vesicles in aqueous media⁽¹⁾.

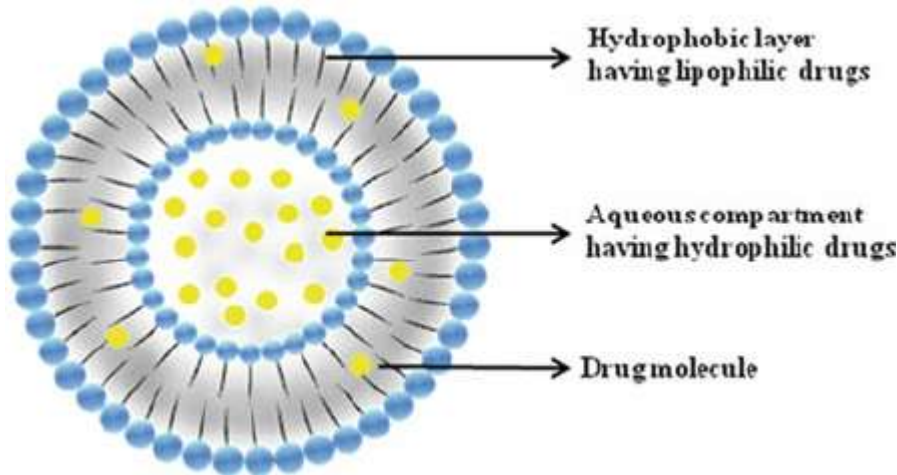


Fig-3 Niosome along with the drug entrapped

Preparation methods:

Various methods are reported for the preparation of niosomes. Such as

1. Ether injection method
2. Hand shaking method (Thin film hydration technique)
3. Sonication method
4. Reverse phase evaporation technique (REV)
5. Micro fluidization
6. Multi membrane extrusion method
7. Trans membrane pH gradient (inside acidic) drug uptake process (remote loading)
8. Bubble method
9. Formation of niosomes from proniosomes⁽⁹⁾

Advantages of niosomes:

- Better patient compliance and better therapeutic effect in comparison to oily formulations
- Can be used to deliver hydrophilic, lipophilic as well as amphiphilic drugs and can accommodate drugs with wide range of solubility
- Controlled and sustained release of drugs due to depot formation
- Enhance the oral bioavailability of the drugs
- Osmotically active and stable, biocompatible, nontoxic and nonimmunogenic
- Protect the drug from enzymatic metabolism thus increase the stability of the drug
- Drug targeting to various organs
- Enhance the skin permeation of various drugs
- Easy to handle, store and transport
- Administered by various routes via oral, parenteral, topical etc,
- The shape, size, composition and fluidity of niosomes can be controlled as and when required⁽¹¹⁾

Therapeutic applications of niosomes:

Niosomal drug delivery is potentially too many pharmacological agents for their action against various diseases. Some of their therapeutic applications are

- Targeting of bioactive agents
 - ✚ To reticular endothelial system (RES)
 - ✚ To organs other than RES
- Neoplasia
- Immunological applications of niosomes
- Transdermal delivery of niosomes⁽⁵⁾

Ethosomes:

The vesicles have been well for their importance in cellular communication and particle transportation for many years. The enhanced delivery of actives incorporated in the ethosomes can be ascribed to the interactions between the ethosomes and skin lipids. That may open the new pathways due to the malleability and fusion of ethosomes with skin lipids, which results in the penetration of drug into deeper skin layers⁽¹⁶⁾. Ethosomes are soft lipid vesicles of size range from tens of nanometres to microns. Hence, size of ethosomal vesicles increase with decrease in concentration of ethanol^(22, 23).

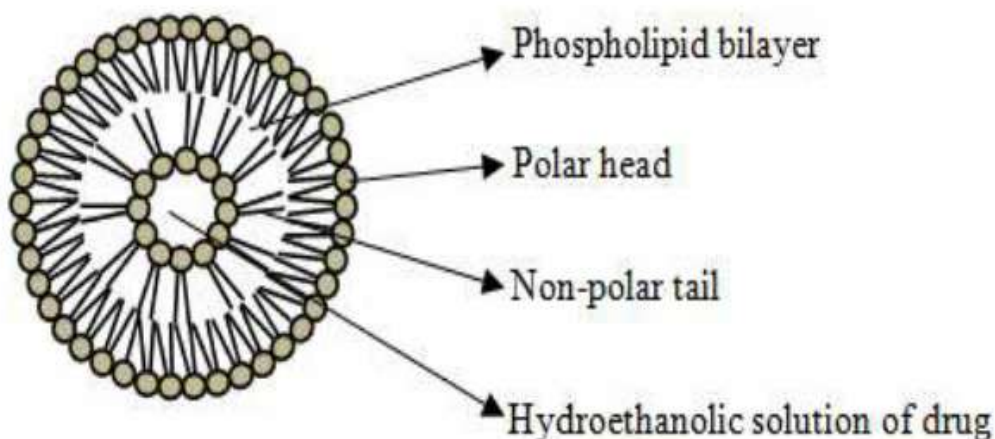


Fig- 4Ethosomes

Methods of preparation:

There are 2 methods which can be used for the formulation and preparation of ethosomes. Both of the methods are very simple and convenient and do not involve any sophisticated instrument or complicated process. They are:

1. Hot method
2. Cold method⁽⁵⁾

Advantages:

- Delivery of large molecules is possible (peptides, proteins)
- Contains nontoxic raw material in formulation
- Enhanced permeation of drug through skin for TDD
- Applied widely in pharmaceutical, veterinary, cosmetic fields
- High patient compliance due to application through semisolid form

- Simple method for drug delivery in comparison to iontophoresis and phonophoresis and other complicated methods
- It is passive, non-invasive and is available for immediate commercialization⁽²⁾.

Therapeutic applications:

- Used for many purposes in drug delivery
- Used as replacement of liposomes mainly for transdermal delivery
- Used for transdermal delivery of hydrophilic and impermeable drugs through the skin
- Various drugs like acyclovir, erythromycin, and insulin have been used with ethosomal carrier⁽⁵⁾

Transferosomes:

Transferosomes are vesicles composed of phospholipids with surfactant and ethanol as well as ultraformable vesicle possessing an aqueous core surrounded by the complex lipid bilayer. Higher membrane hydrophilicity and flexibility of transferosomes tend to avoid aggregation and fusion. Transferosomes were introduced for the effective transdermal delivery of number of low and high molecular weight drugs. It can penetrate the intact stratum corneum spontaneously along two routes in the intracellular lipid that differ in their bilayers properties. It consists of both hydrophilic and hydrophobic properties; high deformability gives better penetration of intact vesicles.

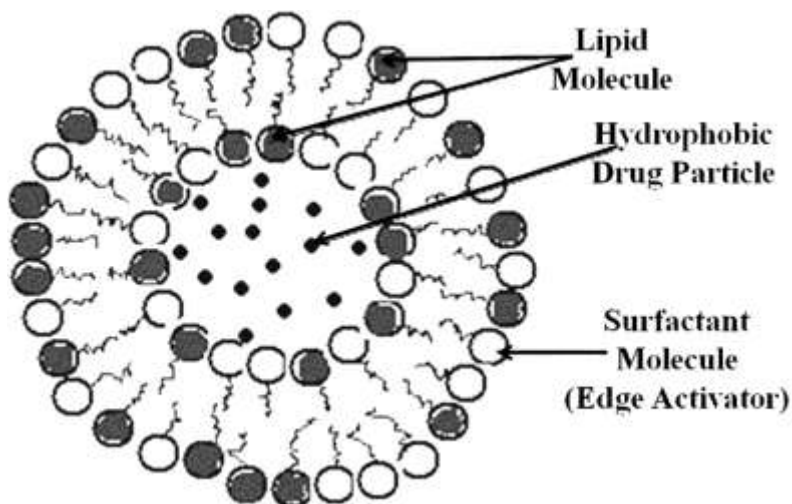


Fig-5Transferosomal Components

Method of Preparation:

Phospholipids, surfactants and the drug are dissolved in alcohol. The organic solvent is then removed by rotary evaporation under reduced pressure at 40°C. Final traces of solvent are removed under vacuum. The deposited lipid film is hydrated with the appropriate buffer by rotation at 60 rpm for 1 hour at room temperature. The resulting vesicles are swollen for 2 hours at room temperature. The multilamellar lipid vesicles (MLV) are then sonicated at room temperature to get small vesicles⁽⁵⁾.

Advantages:

- Contain hydrophobic and hydrophilic moieties together and as a result can accommodate drug molecules with wide range of solubility
- Transferosomes can deform and pass through narrow constriction (from 5 to 10 times less than their own diameter) without measurable loss
- Possess high entrapment efficiency, in case of lipophilic drugs near to 90%
- Used for both systemic as well as topical delivery of drug⁽³³⁾

Limitations:

- Transferosomes are chemically unstable because of their predisposition to oxidative degradation
- Purity of natural phospholipids is another criterion militating against adoption of transferosomes as drug delivery vehicles
- Expensive⁽³³⁾

Pharmacosomes:

“Pharmakon” means linking a drug and “soma” means carrier⁽¹⁰⁾. The limitations of transferosomes can be overcome by the “pharmacosome” approach. The prodrug conjoins hydrophilic and hydrophobic properties and therefore acquires amphiphilic characters and similar to other vesicle forming components was found to reduce interfacial tension, and at higher concentration exhibit mesomorphic behaviour⁽¹⁵⁾. Any drug possessing an active hydrogen atom (COOH, -OH, -NH₂ect.) can be esterified to the lipid with or without spacer chain that strongly result in an amphiphilic compound which will facilitate membrane, tissue or cell as well as poorly lipophilic drugs⁽¹⁰⁾. The salient features of Pharmacosomes are:⁽¹⁾

- Entrapment efficiency is not only high but predetermined, because drug itself in conjugation with lipids forms vesicles.
- Unlike liposomes, there is no need of following the tedious, time consuming step for removing the free, untrapped drug from the formulation
- Since the drug is covalently linked, loss due to leakage if drug does not take place
- No problem of drug incorporation
- Encapsulated volume and drug bilayer interactions do not influence entrapment efficiency, in case of pharmacosomes. These factors on the other hand have great influence on entrapment efficiency in case of liposomes
- Lipid composition in liposomes decides its membrane fluidity, which in turn influences the rate of drug release, and physical stability of system

Advantages:

- Effective tool to achieve desired therapeutic goals like drug targeting and controlled release
- High and predetermined entrapment efficiency
- Volume of inclusion doesn't influence entrapment efficiency
- No need to remove free, untrapped drug
- Improves bioavailability for poorly soluble drugs⁽¹²⁾

Disadvantages:

- Covalent bond required to protect leakage of drugs
- Amphiphilic nature is important for synthesis of compounds
- On storage undergoes fusion, aggregations & chemical hydrolysis⁽³⁴⁾

Preparation methods:

Generally, pharmacosomes are prepared by 2 methods⁽³⁵⁾:

1. Hand shaking method
2. Ether injection method

Colloidosomes:

Colloidosomes are hollow shell microcapsules consisting of coagulated or fused particles at interface of emulsion droplets. Colloidosomes have exciting potential application in controlled release of drugs, proteins, vitamins as well as in cosmetics and food supplements. They have a great encapsulation efficacy with a wide control over size, permeability, mechanical strength and compatibility. It is a novel class of microcapsules whose shell consists of coagulated or fused colloidal particles at interface of emulsion droplet. The particle self-

assembles on surface of the droplet in order to minimize total interfacial energy forming colloidosomes. Hairy colloidosomes whose shell consists of aqueous gel core and shells of polymeric microrods. This has been achieved by templating water-in-oil emulsion stabilized by rod like particles followed by gelling of the aqueous phase, dissolution of oil phase in ethanol and redispersion of obtained colloidosome microcapsules in water⁽¹²⁾.

Advantages:

- Control of size allows flexibility in applications and choice of encapsulated materials
- Great potential in controlling permeability of entrapped species and allow selective and time release
- Control of mechanical strength⁽¹²⁾

Herbosomes:

The term 'herb' means plant, while 'some' means cell like. Over the past century phytochemical and phytopharmacological sciences established the compositions; biological activities and health promoting of numerous botanical products⁽²⁾. Most of the biological active constituents of plant are polar or water-soluble molecules. However, water soluble phytoconstituents are poorly absorbed due to their poor lipid solubility, severely limiting their ability to pass across the lipid rich biological membranes, resulting poor bioavailability⁽¹²⁾. Herbosomes exhibit better pharmacokinetic and pharmacodynamic profile than conventional herbal extracts. Molecular layer consisting of PC and other phospholipids provides a continuous matrix into which the proteins insert⁽¹²⁾.

Advantages:

- Enhances the absorption of lipid insoluble polar phytoconstituents through oral as well as topical route showing better bioavailability
- Dose requirement is reduced
- Phosphatidylcholine used in preparation also acts as hepatoprotective
- Permeates non-lipophilic botanical extract to be better absorbed in intestinal lumen
- Better stability profile due to chemical bonds formed between Phosphatidylcholine molecules and phytoconstituents²

Sphingosomes

Sphingosomes may be defined as "concentric, bilayered vesicle in which an aqueous volume is completely by a membranous lipid bilayer mostly composed of natural or synthetic sphingolipid⁽²⁴⁾." Sphingosomes solve the major drawback of vesicle system like less stability, less in vivo circulation time, low tumor loading efficacy in case of cancer therapy. Sphingosomes are clinically used delivery system for chemotherapeutic agent, biological macromolecules and diagnostics⁽⁵⁾. They may be administered orally or transdermally. In simple way we can say sphingosome is liposomes which are composed of sphingolipid⁽¹⁰⁾.

Advantages:

- Provide selective passive targeting to tumor tissue
- Increase efficacy and therapeutic index
- Increase stability via encapsulation
- Reduction in toxicity of encapsulated agent
- Improved pharmacokinetics⁽¹²⁾

Layerosomes:

The layer-by-layer coating concept in one of the strategies used for the preparation or the stabilization of nanosystems. The layerosomes are conventional liposomes coated with one or multiple layers of biocompatible polyelectrolytes in order to stabilise their structure. The formulation strategy is based on an alternative coating procedure of positive poly (lysine) (pLL) and negative poly (glutamic acid) (pGA) polypeptides on initially charged small unilamellar liposomes. Drawback of liposomes is their instability during

storage or in biological media which is related to surface properties. This surface modification stabilized the structure of liposomes and led to stable drug delivery systems. Oral administration or their incorporation in biomaterials are among potential fields of application. Thus, the concept of layerosomes has brought forward the stable nanosystem⁽²⁾.

Ufosomes:

The formation of fatty acids vesicles is named “ufosomes,” ufosomes are unsaturated fatty acid liposomes. Fatty acid vesicles are colloidal suspensions of closed lipid bilayer that are composed of fatty acids and their ionized species. They are observed in a small region within the fatty acid-soap-water ternary phase diagram above the chain melting temperature of corresponding fatty acid soap mixture. Fatty acid vesicles always contain two types of amphiphiles, the nonionized neutral form and the ionized form. The ratio of nonionized neutral form and the ionized form is critical for the vesicle stability. Fatty acid vesicles are actually mixed “fatty acid/soap vesicles.” Ufosome membranes are much more stabilized in comparison to liposomes⁽¹²⁾.

Strategies To Improve VDDS:

To improve VDDS mainly 2 strategies are reported:

➤ Pro-vesicular drug delivery:

Developed to overcome the stability problems associated with vesicular drug delivery systems composed of dry products or liquid crystalline gel that can be hydrated immediately before use.

e. g., Proliposomes, Proniosomes⁽⁹⁾

Characterization:

Morphology, Angle of repose, Rate of hydration, Degree of deformity & permeability measurements, Size & Size distribution etc.

Types of pro-vesicular drug delivery system:

1. Proliposomes
2. Proniosomes

➤ Improve permeability:

- a. Physical means
- b. chemical means

Future Prospects in VDDS:

Aquasomes:

Three layered self-assembly compositions with ceramics carbon nanocrystalline particulate core coated with glassy cellobiose specific targeting and molecular shielding⁽³⁶⁾.

Cryptosomes:

Lipid vesicles with a surface coat composed of pc and of suitable polyoxyethylene derivative of phosphotidyl ethanolamine, capable of ligand mediated drug targeting.

Discosomes:

Discosomes are niosomes solubilized with non-ionic surfactant solutions. They show ligand mediated drug delivery.

Emulosomes:

Nanosize lipid particles consisted of microscopic lipid assembly with a polar core used parenteral delivery of poor water-soluble drugs.

Enzymosomes:

Liposomal constructs engineered to provide a mini bioenvironmental in which enzymes are covalently immobilized or coupled to the surface of liposomes. Targeted delivery to tumor cells.

Genosomes:

Artificial macromolecular complexes for functional gene transfer. Cationic lipids are most suitable because they possess high biodegradability and stability in the blood stream. Cell specific gene transfer.

Photosomes:

Photolysase encapsulated in liposomes, which release the content photo triggered changes in membrane permeability characteristics.

Virosomes:

Liposomes spiked with virus glycoprotein, incorporated into the liposomal bilayers based on retro viruses derived lipids.

Vesosomes:

Nested bilayer compartment in vitro via inter digested bilayer phase formed by adding ethanol to a variety of saturated phospholipids. Multiple compartments of vesosomes give better protection to interior contents in serum.

Proteosomes:

High molecular weight multi-subunit enzyme complexes with catalytic activity, which is specifically due to assembly pattern of enzymes. Better catalytic activity turnover than non-associated enzymes.

Emulosomes:

Hb containing liposomes engineered by immobilizing Hb with polymerisable phospholipids

Erythrosomes:

Liposomal system in which chemically cross-linked human erythrocytes used as support to which lipid bilayer is coated

Enzymosomes:

Enzymes are co-valently immobilized or coupled to surface of liposomes.

Archaesome:

Made from natural archaeal membrane lipids and/or synthetic lipid analogues have been extensively studied for potential applications in drug and vaccine delivery over the past decade only. Archaeal-type lipids consists of archaeal and/or caldarchaeol core structures wherein regularly branched and usually fully saturated phytanyl chains are attaches via ether bonds to the sn-2,3 carbons of the glycerol backbone⁽⁹⁾.

Conclusion:

Vesicular system has been realized as extremely useful carrier system in various scientific domains. Because of the site-specific targeting of drugs and lots of other advantages, vesicular drug delivery system is

gaining popularity in present scenario. Drugs can be easily and directly targeted to their site of action to prevent toxicity and undesired effects to other sites, further these can be used for bioavailability enhancement, to reduce the dose of the drug administered and to enhance the pharmacological action of drug. Utilization and solving of critical issues of pharmaceutical field by outstanding example of vesicular drug delivery systems such as liposomes, niosomes etc, have been very much useful drug delivery system in current field and have remarkable place in pharmaceutical dosage forms over and above to the conventional drug delivery systems.

References:

1. S. S. Biju, Sushama Talegaonkar*, P. R. Mishra and R. K. Khar; Vesicular systems: An overview. Indian journal of Pharmaceutical sciences, 2006.
2. Namdeo G. Shinde*, Nagesh H. Aloorkar, Ajit S. Kulkarni., Recent advances in Vesicular drug delivery system. Research Journal of Pharmaceutical Dosage Forms and Technology, 2014, 110-120.
3. Mohammad Zishan, PoonamKushwaha, Kuldeep Singh, Mohammad Amir, Vaseem A Ansari, Anup Kumar Sirbaiya and SatyaPrakash Singh, An Overview of: Vesicular drug delivery system. World journal of pharmacy and Pharmaceutical sciences, Vol-6, 546-560.
4. Seema M. J., Pournima M., Mrs. Manisha k., Vilasrao k., Novel vesicular system: An overview. Journal of Applied pharmaceutical sciences, 2012, 193-202.
5. Mohammad Z., Faisal S, MdWasim H, Suhail A, Sahar I, Mohd S, Nazma K., Vesicular drug delivery system used for liver diseases. World Journal of Pharmaceutical Sciences, 2017.
6. Kalpesh C. Ashara, Jalpa S. Paun, and M. M Soniwala., et al., Vesicular drug delivery system: A Novel Approach. Mintage Journal of Pharmaceutical & Medical sciences, Vol-3, 2014.
7. S. Umadevi, K. Sasidharan, K. Nithyapriya, R. Venkatanarayanan., A Review: Vesicular drug delivery- an approach. Indo American Journal of Pharmaceutical Research, 2012:2(8).
8. Sunil Kamboji, Vipin S., Nancy M., Suman B., Vikas J., Vesicular drug delivery systems: A novel approach for drug targeting. International Journal of Drug Delivery 5, 2013, 121-130.
9. SaurabhBansal, Chandan Prasad K., Geeta Aggarwal, SL Harikumar., A Comparative Review on Vesicular drug delivery system and Stability issues. International Journal of Research in Pharmacy and Chemistry 2013, 2(3).
10. Viazoglu, O. and Speiser, P. P., ActaPhrmSuec. 1986, 23, 163.
11. E. Touitou. Ethosomes- novel vesicular carriers for enhanced delivery: Characterization and skin penetration properties. Journal of Controlled Release, 65 2000: 403-418.
12. Jadhav SM, MoreyP, Karpe M, Kadam V., Novel Vesicular System: an overview. J. Appli. Sci. 2012; 2(1): 193-202.
13. Yatvin MB and Lelkes PI. Med. Phys, 1982; 9: 149.
14. Kimball's Biology Pages, "Cell Membranes." Stryer S. Biochemistry, 1981; 213.
15. Dua JS, RanaAC, Bhandari. Liposome: methods of preparation and applications. International Journal of Pharmaceutical Studies and Research /April-June, 2012; 14-20.
16. Sharma M. applications of nanotechnology-based dosage forms for delivery of herbal drugs, research and reviews: journal of pharmaceutics and nanotechnology. March, 2014; 23-30.
17. Gangwar S, Singh S, Garg G. Ethosomes: a novel tool for drug delivery through skin. J Pharm Res. 2010; 3(4): 688-691.
18. Nikalje AP, Tiwari S. Ethosomes: a novel tool for transdermal drug delivery. Int J Res Pharm Sci. 2012; 2(1): 1-2.
19. Gill V, Kumar MS, Khorana B, Arora D, Mahadevan N. Development of amphotericin B loaded modified emulosomes for visceral leishmaniasis: in vitro. Int J Recent Adv Pharm Res 2011; 2: 14-20.
20. Kumar D. Lipoidal soft hybrid biocarriers of supramolecular construction for drug delivery. Int Scholar Res Network Pharm 2012; 1-14.
21. Talegaonkar, S., Vesicular systems: An overview. Indian Journal of Pharmaceutical Sciences, 2006. 68(2): p. 141.
22. V. H. K. Li, J.R.R., V. H. L. Lee; Marcel Dekker Inc, NY, Controlled Drug Delivery: Fundamentals & Applications. 1987.
23. Todd, J.A., Modest, E. J., Rossow, P. W. and Tokes, Z. A., Biochem. Pharmacol. Vol. 34. 1982. 541.
24. Ravi Kumar, S.K., Shyam Shankar Jha, Amit Kumar Jha, Vesicular System-Carrier for Drug Delivery. Pelagia Research Library, 2011. 02(04): p. 192-202.

25. R, B.D.S., Topics in Pharmaceutical Sciences. Vol. 57. 1985: Elsevier Science Publisher, New York USA.
26. Riaz, M., Liposome preparation method. Pakistan Journal of Pharmaceutical Sciences, 1966: p. 65-77.
27. D.D., L., Application of liposome, Liposome Technology. Hand book of biological physics. Vol. 01. 1050 Hamilton Court, Menlo Park, California, USA. 493-515.
28. S. Pandey, M.G., V. Devmurari, J. Fakir, Der Pharmacia Lettre. Vol. 01. 2009. 143-150.
29. F.Volkering, App. Environ. Micro. Vol. 05. 1995. 33.
30. Ifu SP. A Vesicular system, Int. J. Pharm. Vol. 172. 1998. 33-70.
31. Godin B, Ther. Drug Carrier System. Vol. 20. 2003.
