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A Review on Liposomes – A Novel Drug Delivery System

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Abstract: *The Greek word "liposome" means "fat" and "soma" means body. Liposomes are sphere- shaped vesicles made of cholesterol and phospholipids. Its hydrophobic and lipophilic nature makes it a very promising mechanism for the delivery of medications. The goal of the new method of drug delivery is to target the drug directly at the active site. However, the application and development of these products remain challenging because of the costly and time-consuming processes involved in their creation and production. Therefore, in order to overcome these obstacles, further research and development are needed.*

Keywords: Phospholipids, Control release, Liposome and Characteristics

I. INTRODUCTION

A sphere-shaped core vesicle, liposomes, are named after the Greek words lipos, which means fat, and soma, which means body [1]. The new method of drug administration, Liposome, is aimed at providingdrugs directly to the drug site. They can modify hydrophilic and lipophilic substances, protect drugs from deterioration and control the release of active components [2]. Liposomes consist of long chains of fatty acids, glycols, sphingolipids, cholesterol, and membrane proteins. It is a two-layered concentric vesicle with a diameter of 0.01 to 5.0 m [3].

Liposomes are a type of colloidal vein composed of one or more lipid-bilayers with a cavity attachedto water in the middle. Antibiotics, antifungals, cancer drugs, proteins, hormones and peptides are among the medications that can be contained in liposomes. Drug metabolism accelerates the therapeutic level of many drugs, and liposomes are potentially useful system of delivery and storage at the therapeutic level [4].

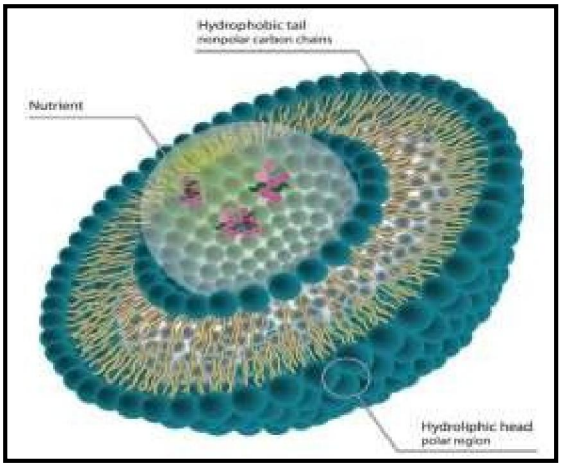

Figure: Structure of Liposome

II. STRUCTURAL COMPONENTS OF LIPOSOMOES

Phospholipids:

Phospholipids are the fundamental structural components of biological membranes, including cell membranes. The head of polar hydrophilic and the tail of lipophilic form phospholipids together. As aresult, lipophilic drug molecules can be incorporated into the lipid layer and hydrophilic drugs can be

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incorporated into the water phase. On the other hand, the two chains of fatty acids that form the waterfoaming tail each contain 0.6 double bonds and 10–20 carbon atoms. Phosphoric acid, which is connected to soluble molecules in water, forms the hydrophilic head.

Cholesterol:

Although cholesterol is not a two-layer structure, it can be integrated into very high concentrations ofphosphate lipid membranes. In the presence of biological fluids such as blood and plasma, membrane permeability increases and decreases. It appears that cholesterol reduces the interaction of blood proteins [5, 6].

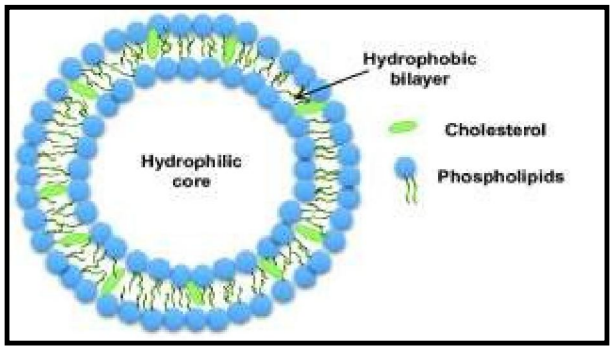

Figure: Structural Components of Liposomes

IDEAL CHARACTERISTIC OF LIPOSOMES IN DRUG DELIVERY [7,8]

- It must be able to support the maximum load.
- It must work well with the location of the installation.
- It must be stable in a physiological environment.
- Toxicity and biocompatibility profiles must be acceptable.
- There should be no negative immune or inflammatory reaction.
- Preserve the biological, chemical and physical processes of the body.

MECHANISM OF ACTION OF LIPOSOMES

Liposomes work through four different mechanisms:

- **Endocytosis:** Endocytosis is observed in retinal endothelial cell phagocyte cells, such asneutrophils [9].
- **Adsorption**: Occurs on the cell surface through non-specific electrostatic forces or interactions with components of the cell surface [10].
- **Fusion -** The reaction in which the liposomal layer is introduced into the plasma membraneand the liposomal content is continuously released into the cell [11].
- **Lipid exchange:** Lipid exchange is the transfer of lipids from the liposome to the cellmembrane without the related contents of the liposome [12].

ADVANTAGES OF LIPOSOMES

- Improvement of the efficacy and therapeutic index of drugs [13].
- Non-ionic
- Prevents drug oxidation. Liposomes are biodegradable [14].
- Biocompatible lipids improve drug stability [15].
- Location avoidance effect. Improve protein stability [16].
- Ensure continuous release
- Direct interaction between drugs and cells.
- The effect of site avoidance.

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DISADVANTAGES OF LIPOSOMES

- Low solubility.
- The half-life is short.
- Production costs are high [17].
- There may be leakage and fusion of encapsulated drugs.
- Oxidation of phospholipids occurs [18].
- Stability is less stable.

STABILITY OF LIPOSOMES

The therapeutic effect of pharmaceutical molecules depends on the stability of liposomes. There are two types of stability:

- **Physical stability:** Various physical processes influence the life expectancy of liposomes, such as fusion, aggregate, shape and size. The shape and distribution of sizes are important parameters for stability. Physical stability can be maintained by avoiding excessive phospholipid unsaturation. They should be stored at 4◦C without freezing or exposure to light [19].
- **Chemical stability:** Phosphate is a water-resistant unsaturated fatty acid that changes the stability of pharmaceuticals. Add antioxidants such as butylated hydroxyanitre to avoid oxidation of liposomes [20].

ANATOMY OF LIPOSOMES

Liposomes are small bubbles and vessels composed of cell membranes. These liposomes are full of drugs and are ideal for the treatment of certain diseases and cancers. The liposome membrane consists of a group of phospholipids with heads and tails. The log hydrocarbon chain makes the head group water-soluble and the tail group water-soluble. In the natural world, phospholipids are stored in a stable membrane composed of two layers. In the presence of water, the head group is drawn to water by its rich water content and integrates into the surface structure far from water.

In cells, there are two layers: one of the heads attracts external water, the other one attracts internal water. Hydrophobic tail groups are linked and form double layers. When the phospholipids in the membrane are disturbed, they become small spheres, smaller than normal cells in the two or the monolayer. The two layers that form are called liposomes and the monolayers are called micelles. Lipoproteins of plasma membranes are mainly phosphates such as phosphate ethanolamine and phosphate chloride. These phospholipids are amphiphilic, molecules' hydrocarbon tails are hydrophobic, and polar heads are hydrophilic. In the composition of liposomes, phospholipids are mixtures of lipid chains and pure substances such as DOPE (Diolylphosphatedylethanolamine) [21, 22.23].

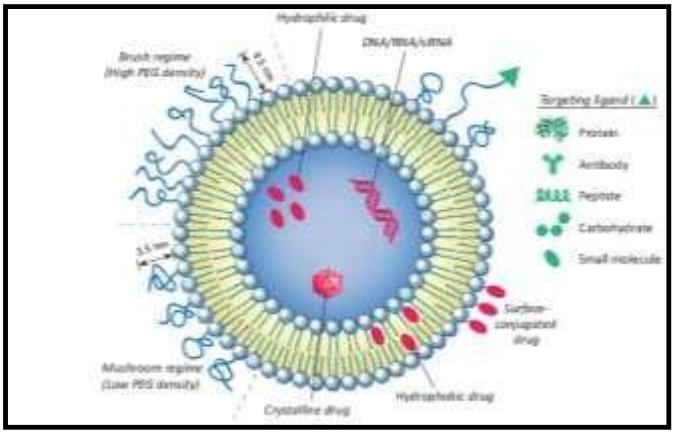

Figure: Anatomy of Liposomes

COMPOSITION OF LIPOSOMES

Liposomes are composed mainly of phosphate, cholesterol and other non-ion lipid molecules. Lipid is a major component of liposomes, usually used in liposome formulations, accounting for 50% of the weight of biological

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membrane lipids. The components of the liposome formulations include phosphate lipids, phosphate chlorides, phosphate glycosides, phosphate acids, phosphate ethaneamines and phosphate serinin. Cholesterol has a profound and modulating effect on the properties of the lipid bilayer. As a liquid buffer, it reduces the flexibility of the lipid chain around it. Cholesterol molecules are molecules that are bound to cholesterol [24].

III. EVALUATIONS OF LIPOSOMES

- **Vesicular shape and lamellarity:** Vesicular shape is studied with an electron microscope.
- **Particle size and distribution:** The analysis of laser diffraction analyzers with a minimumpower of 5 MW [25]. The amount of drugs trapped in the liposome helps to estimate the behavior of the drugs in the biological system.
- **Encapsulation Efficiency (EE):** The percentage of encapsulation of drugs is first separated from the component of the free drug from the component of the encapsulated drug. Then thecapsule is pumped into the suitable detergent from the liposome and dissolved in water solution [26].
- **Surface Charge:** The surface charge measurement method is based on the free flow electrophoresis of the multilayer variable (MLV).
  Use a plate of cellulose acetate coated with a sodium borate buffer at pH 8.8.
  Subsequently, approximately 5N molecular lipid samples were applied to the plateand electrophoresized for 30 minutes.
  Liposome gels are divided according to surface load.
  This technique can be used to determine the heterogeneity of the load of lipid suspensions and to detect impurities such as fatty acids [27].

APPLICATIONS OF LIPOSOMES [28, 29, 30, 31, 32]

- **Respiratory disorders:** Liposomes are more stable than conventional aerosols, havebetter stability, and are less side effects than drugs. Liquids and dry forms can be inserted into the form of neonid liposomes.
- **Tumor therapy carrier:** Liposomes are developed as nano-carriers forchemotherapy. Many drugs are already approved for chemotherapy.
- **Eye diseases:** Liposomes have a positive effect on many eye diseases, including dryness, corneal rejection, etc. The drug verteporfin has been approved as a liposomalformulation for visual disorders.
- **Liposomal application:** Liposomes are one of the best tools for drug pulmonary delivery because of their superior solubility characteristics.
- **Liposomes in cosmetics:** Liposomes are also used in cosmetics because they have arelease pattern similar to cell membranes
- **Specific targeting of the site:** immune liposomes can identify and connect with the targeted cells more sensitivity.
- **Liposomes as pharmaceutical delivery of proteins:** Liposomes are used to increasedrug solubility.
- **Genetic therapy:** Liposomes are widely used in genetic therapy.

ADVANCEMENTS IN LIPOSOMES

- Ethosomes: They have an effective effect on the delivery of soya phosphatidylcholin and 30% ethanol to the skin [20].
- Immuno liposomes: Immuno- Liposomes are modified by antibodies.
- Niosomes: Niosomes are small, unilamellar vesicles of non-ionic surfactants [33].
- Stealth Liposome: This new type of liposome is developed to improve circulation stability and increase the half-life of circulation. Polyethylene glycol (PEG) is used to coat lipids in liposome preparations [34].

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IV. CONCLUSION

Liposomes play a role in general medicine and ophthalmology. Its ability to improve treatment rates, reduce toxicity, provide selective drugs and improve imaging technologies has made it a valuable medical tool. The present study presents the main method for integrating hydrophilic and hydrophilic nanoparticles into liposomes and shows the appropriate plan for successful experimental methods.

Liposomes are one of the best options for delivering nanocarriers, delivering specific locations, delivering specific organs, and targeting receptors. Liposome formulations must be well designed to achieve better bioavailability and low side effects to achieve better results.

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