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Pharmaceutical Sciences **Review Article……!!!**

RECENT APPLICATIONS OF LIPOSOMES: A REVIEW

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ABSTRACT

Liposomes are sphere-shaped vesicles made of one or more phospholipid bilayers and are the most extensively researched nano-drug carriers in drug delivery. Targeted delivery, high biocompatibility, biodegradability, ease of functionalization, minimal toxicity, improvements in the prolonged release of the medication it carries, and better therapeutic indices are just a few of the notable characteristics liposomes have over conventional drug delivery systems. The most current uses of liposomes are discussed in this minireview.

INTRODUCTION:

Liposomes are lyotropic liquid crystals that have an aqueous core enclosed by one or more bilayers of natural or synthetic phospholipids. They are made of reasonably biocompatible, biodegradable materials. Dr. Alec D. Banggham, a British hematologist, originally described liposomes [1] in 1961 at the Babraham Institute in Cambridge. In terms of structure, liposomes are concentric vesicles in which a membranous bilayer completely encloses an aqueous volume. They can serve as a nontoxic delivery system for insoluble pharmaceuticals and can successfully encapsulate and transport both hydrophilic and lipophilic compounds.

They are adaptable drug carriers that can be employed to manage drug retention while entrapped in biological fluids, manage vesicle residence in the systemic circulation or other bodily compartments, and improve vesicle uptake by target cells. The majority of the phospholipids in liposomes are glycerophospholipids and sphingomyelin. Phospholipids are amphiphilic compounds containing hydrophobic tail groups and hydrophilic head groups[2].

The usual processes for creating liposomes include thin-film hydration, reverse-phase evaporation, ethanol injection, sonication, extrusion, high-pressure homogenization, and freeze-thaw. However, alternative methods can also be combined with ultrasonic, extrusion, high-pressure homogenization, and freeze-thaw technology.

RECENT APPLICATIONS OF LIPOSOMES IN DRUG DELIVERY[3,4]

1. Formulation support

A variety of water-insoluble (lipophilic) medications can be contained within liposomes, which are made of lipids that are generally nontoxic, non-immunogenic, biocompatible, and biodegradable molecules. There are marketed liposome products like Doxil™, Ambisome™, Dauno Xome™, etc. available.

2. Intracellular drug delivery

Some medications, such as N-(phosphonacetyl)-L-aspartate (PALA), which are often poorly absorbed into cells, can be increased in cytosolic administration using liposomes. Through fluid phase endocytosis (pinocytosis), PALA is picked up by tumor cells and diffuses into the cytoplasm as the pH of the endosomes decreases.

3. Site avoidance delivery

The majority of drugs used to treat conditions like cancer has a limited therapeutic index (TI) and can be extremely hazardous to healthy tissues. By reducing distribution to vital normal organs, these medications' toxicity can be reduced. It has been demonstrated that liposome encapsulation can dramatically minimize the medication toxicity by even slightly reducing the drug's delivery to vital organs.

4. Liposomes in gene therapy

The possibility of using cationic liposomes as a nonviral human gene delivery mechanism has been explored. They typically consist of a neutral phospholipid (DOPE) and a cationic lipid derivative.Lipofecttin (DOTMA:DOPE,1:1), Lipofectamine (DOSPA:DOPE,3:1), and Transfectace (DDAB:DOPE,1:3) are the most popular cationic liposome formulations.Instead of being enclosed in liposomes, the negatively charged genetic material (plasmid) is electrostatically complexed with cationic lipids. It is believed that plasmid-liposome complexes fuse with the plasma or endosome membrane to enter the cell.

5. Liposomal as carriers of proteins

Liposomal encapsulated enzymes have the ability to penetrate the cytoplasm or lysosomes of living cells for the treatment of hereditary disorders (such as lysosomal storage disease) caused by the aberrant functioning of some intracellular enzymes. When compared to free enzymes, the use of liposomally encapsulated asparaginase increases the longevity of animals with asparagine-dependent P1534 tumors.

6. Lymphatic targeting with liposomes

Plain and ligand targeted liposomes are used as a potentially useful method to target lymphatics for therapeutic and diagnostic applications. The subcutaneous administration of liposomes provides in their uptake by draining lymphatic capillaries at the injection site and active capture of liposomes by macrophages in regional lymph nodes. Gadolinium(Gd)-loaded liposomes are utilized for magnetic resonance imaging (MRI) and for the lymphatic administration of methotrexate.

7. Liposomal vaccines

To enhance the immune response to antigenic peptides, liposomes are employed to deliver peptide vaccines and cytotoxic T lymphocyte (CTL) epitopes to dendritic cells (DCs).Peptide vaccines in liposomal formulations load and activate DCs, triggering immunological responses that are protective against viruses and tumors. Inhaled ricin protection was produced using formaldehyde-inactivated ricin toxoid in liposomes for intrapulmonary vaccination.

8. Liposomes in diagnostic imaging

For experimental diagnostic imaging of the liver, spleen, brain, circulatory system, malignancies, inflammation, and infections, liposomal contrast agents are utilized. A sufficient amount of radionuclide or paramagnetic metal must be linked with the liposome for gamma scintigraphy and MRI. Iodinated organic compounds, which are computerized tomography contrast agents, can be added to the liposome membrane or employed in the inner water compartment. It is possible to create liposomes for sonography by adding gas bubbles or by

creating the bubble inside the liposome as a result of a chemical reaction, such as bicarbonate hydrolysis, which produces carbon dioxide. In a pig model, gas bubbles stabilized inside the phospholipid membrane show these contrast agents to have good performance and low toxicity.

9. **Enhanced solubility of amphiphilic and lipophilic drugs:**

Acyclovir and Doxorubicin, two anticancer treatments, can be encapsulated in liposomes at concentrations that are many times higher than their solubility in water. This is made possible by the medication or gel structure precipitating inside the liposome with the required ingredients contained.

10. **Precise targeting of Location:**

In some circumstances, liposomes with surface-attached ligands can bind to target cells or can be carried into the target tissue by regional anatomical abnormalities including leaky and improperly constructed blood arteries, their capillaries, and basal lamina. Examples include cancer, sickness, and provocative pharmacological treatments.

11.In Foods

Due to their capacity to boost bioactive dissolution rate and bioavailability, safeguard delicate chemicals, enhance stability throughout processing, storage, and digestion, and stifle unwelcome odors, liposomes have grown in popularity in the food sector for functional purposes. Vitamins that are liposoluble are rarely used in aqueous-based food formulations because they are rapidly oxidized in the atmosphere. The majority of vitamins are also thermolabile, meaning they can easily deteriorate when subjected to thermal processes like pasteurization.

12.In Cosmetics

Since they can be a promising method for creating antiperspirants, creams, lipsticks, deodorants, moisturizers, hair care products, etc., liposome-based nanoformulations are attracting a lot of attention. They can also be used to successfully deliver vitamins like vitamin A, B12, E, and K, antioxidants (like coenzyme Q10, lycopene, carotenoids, etc.), and other bioactive molecules.

CONCLUSION

Simple production procedures and a wide range of quality control assays for liposomal formulations must be added to the growing number of suggested applications and encouraging results from early clinical applications and clinical trials of various liposomal medications. These advancements should prevent future overly optimistic predictions and pave the way for a new, more fruitful and creative phase of liposome research.

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