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Liposomes: A short Review

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Abstract
Liposomes have a vast range of uses that have always been widened and improved upon since it was first noted that it was able to self-assemble into vesicles. These arrangements are found in many different shapes as well as sizes depending on the lipid composition. Liposomes are often being used to transport molecular cargos such as deoxyribose nucleotide for therapeutic benefits. Due to varied scientific applications of liposomes, they are under extensive investigation as drug carriers for enhancing the delivery of therapeutical agents. As a result of new developments in liposome technology, many liposome- based drug formulations are being investigated, and lately some of them have been approved for clinical use.

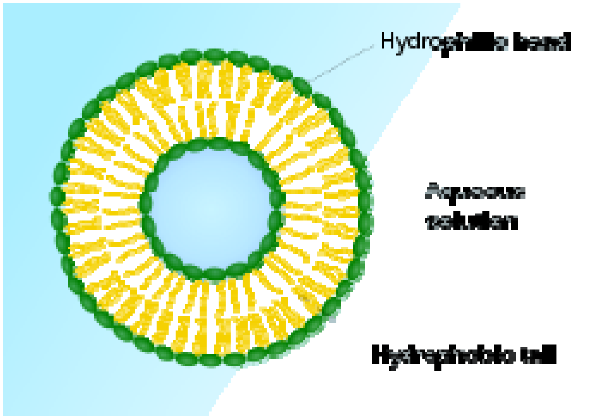
INTRODUCTION

Liposomes were first described by British haematologist Dr Alec D Bangham [1][2][3] FRS at the Babraham Institute, in Cambridge when they were discovered by him and R. W. Horne, who were testing the institute's new electron microscope by adding negative stain to dry phospholipids. The name liposome is derived from two Greek words: 'Lipos' meaning fat and 'Soma' meaning body. A liposome is a tiny bubble (vesicle), made out of the same material as a cell membrane. They are usually made of phospholipids, which are molecules that comprise a tail and a head group. The head is hydrophobic, whereas the tail which is made of a long hydrocarbon chain is hydrophilic. Normally, phospholipids can be found as a bilayer. [4][5] When in contact with water, the head will line up to face the water. In cells, one layer of hydrophilic heads faces the external environment of cell while another layer faces the internal environment of cell. The hydrophobic tails of both layers then face each other to form a bilayer. [6]

Liposomes are vesicular structures that can be formed with the accumulation of lipids that interacts with one another in a specific manner. [7] Depending upon the composition and the structure, liposomes can separate hydrophobic or hydrophilic molecules from the solution. [8][9] These vesicles are not strong formations but rather are fluid entities that are complex supramolecular assemblies. Because of their dynamic properties and relatively easy manipulative ability, liposomes have been used widely in the analytical sciences as well as for drug and gene delivery.

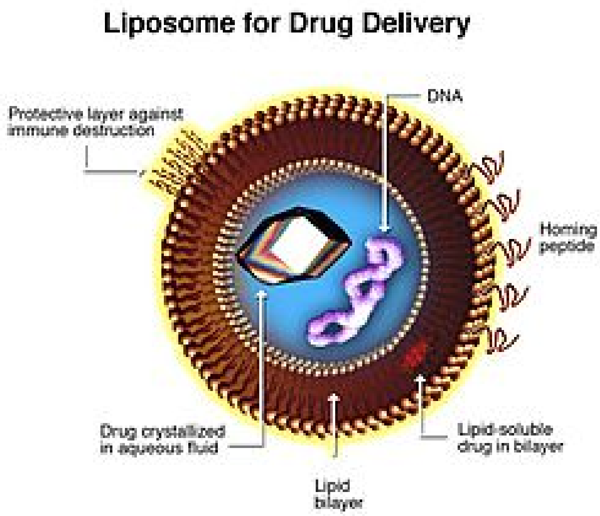
When the structural layer of phospholipid is disrupted, they are able to realign themselves into smaller structures. [10] These reassembled bilayer structures are known as liposomes while a monolayer is called micelle. [11] A liposome can be formed at a variety of sizes. Liposomes which can be filled with drugs, are used in delivering specific drugs in the treatment for cancer and other diseases. [12]

Liposomes can be classified into multilamellar vesicle, unilamellar vesicle, and the cochleate vesicle. [3] Moreover, they are composite structures made of phospholipids and may contain small amounts of other molecules. Though liposomes can vary in sizes, unilamellar liposomes are generally smaller in size with various targeting ligands attached to their surface that allows an increase in their surface-attachment area that enhances its efficiency in the treatment of various diseases . [13]



Schematic diagram of a liposome that is formed by phospholipids in an aqueous solution.

Source: www.liposome.com



Source: www.enzymatic.com

Liposome is known to have an artificially-prepared vesicle made of a lipid bilayer, which can be prepared by altering biological membranes. As a result, it can be used as a means of administering nutrients and drugs. Liposomes can be classified into multilamellar vesicle, unilamellar vesicle, and the cochleate vesicle. [14] Thus a liposome blueprint enables surface ligands to get attached to unhealthy tissues.

DISCUSSION

Liposomes In Drug Delivery

Liposomes are mainly used in drug delivery due to their unusual yet unique properties. A liposome is able to encapsulate a region of aqueous solution inside a water repelling membrane [12]. This otherwise called hydrophobic membrane will not allow dissolved hydrophilic solute to readily pass through the lipids. Hydrophobic chemicals on the other hand can be dissolved into the membrane which allows liposome to carry both hydrophobic and hydrophilic molecules. [15] The molecules are delivered to sites of action when the lipid bilayer fuses with the other bilayer such as the cell membrane.

Another way of delivering drugs is by targeting the endocytosis events. Liposomes can be made as targets for macrophages in the body. The drugs are released while the liposomes are being digested by the macrophage. Endocytosis in other cells can be triggered by administrating liposomes decorated with opsonins and ligands [16].

Artificial cells are synthesized by using liposome as models. The blueprint of liposomes can be manipulated in such a way that enables it to deliver specific drugs in many other ways. Generally drugs are delivered via direct cell fusion method. Liposome on the other hand, can be constructed such that drugs can be delivered via diffusion method [17]. In some liposomes, dissolved aqueous drugs will exist in a charged state. As the pH within the liposome naturally neutralizes, the drug will in turn also be neutralized. This allows it to pass freely through the necessary membrane. [18]

Liposomes and Transport

In addition to drug delivery application, liposomes are used as means of transport for the delivery of dyes in textiles [19], pesticides to plants, nutritional supplements to foods, and cosmetic products to skin. [20]

The uses of liposome have been closely related to the delivery of drugs until very recently. Liposome's versatile abilities are now being discovered in many other settings. By the aid of liposomes, certain dietary and nutritional supplements can now be delivered to the targeted area. [21]

Liposome as a Scavenger

Toxicity of drugs on the body can be prevented by injecting empty liposomes with a trans-membrane pH gradient. The vesicles will act by scavenging the drugs that is circulated in blood. [22]

Liposome in Lipofection

Liposomes are also used for the transformation of DNA into a host cell and it is called lipofection. [11]

Liposome and its role in Nano Cosmetology

Apart from that, liposome plays a beneficial role in nano cosmetology. Among the benefits are, better penetration as well as diffusion of active ingredients, increased stability of active ingredients, increase in release time and decrease in negative complications. [23][24]

Liposome and its role in Treating Cancer

Another unique property of liposomes are their ability to target cancer cells. [25] Endothelial cells found in healthy human blood vessels are held together by tight junctions. The presence of these tight junctions prevents large particles found in the blood from leaving the vessel. Tumour vessels on the other hand, does not contain as many tight junctions as healthy vessels and is hence described to be leaky. Therefore liposomes of smaller sizes are able to gain access to tumour sites from the blood and are kept in the bloodstream in healthy vessels.

CONCLUSION

In conclusion, liposomes have a diverse range of uses ever since it was first noted that it was able to self-assemble into vesicles. Their ability to form a bilayer has allowed liposomes to be an efficient carrier. New liposomes, with efficient lipid molecules, and new formulations has managed to open up possibilities for safely and effectively treating many diseases including cancers.

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