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REVIEW ON NIOSOME AS NOVEL DRUG DELIVERY SYSTEM

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ABSTRACT

Niosome are novel drug delivery system, in which the medications are encapsulated into vesicle. Niosomes are formations of vesicles by hydrating the mixture of cholesterol and non-ionic surfactants. Non-ionic surfactant vesicles have been seen lot of advantage in the area of novel drug delivery systems due to their salient features such as biodegradability, biocompatibility, chemical stability, low production cost, easy storage, easy to handle, and low toxicity. Niosomes are thought to be the better candidate's drug delivery system due to their various factor like cost, chemical stability, etc. various types of drug delivery is possible using niosomes like targeting drug action, ophthalmic, parenteral. Many Novel drug delivery systems have been reported through various routes of administration, to achieve controlled and targeted drug delivery.

KEYWORDS: Niosomes, Novel drug delivery, non-ionic surfactant, Vesicle.

INTRODUCTION

Niosomes are novel drug delivery system, which entrapped the hydrophilic drug into core cavity and hydrophobic drug into the non-polar region present within the bilayer, hence both the hydrophilic and hydrophobic drugs can be incorporated into niosome. The main reason of developing a niosomal system is chemical stability, biodegradability, biocompatibility, low production cost, easy storage, easy handling, and low toxicity. Niosome can be administrated through various routes such as oral route, parenteral route, topical route, ocular route etc.[1,2,3] Niosomes are non-ionic surfactants vesicles obtained by the hydration of synthetic non-ionic surfactants, with or without incorporation of cholesterol or other lipids. They are vesicular system similar to the liposomes that can be used as carriers of amphiphilic and lipophilic drugs.[4, 5]

In the niosome drug delivery system, the medication are encapsulated in a vesicle. The vesicle is composed of a bilayer of non-ionic surfactants and hence the name niosomes.[6]

For many decades, medication of an acute disorder or a chronic illness has been accomplished by deliver the drugs to the patients via various pharmaceutical dosage forms like tablets, capsules, pills, creams, ointments, liquids, aerosols, parenteral and suppositories as carriers.[7]

Niosomes are one of the best carriers. Structurally, niosomes are similar to liposomes and also are equiactive in drug delivery potential but high chemical stability and economy make niosomes superior to liposomes. Both consist of the bilayer, which is made up of non-ionic surfactant In the case of niosomes and phospholipids in the case of liposomes. Niosomes are microscopic lamellar structures of size range between 10 to 1000 nm and consist of biodegradable, non-immunogenic, and biocompatible surfactants.[8]

The niosomes are amphiphilic in nature, which allows entrapment of hydrophilic drugs in the core cavity and hydrophobic drugs in the non-polar region present within the bilayer, hence both hydrophilic and hydrophobic drugs can be incorporated into niosomes.[9]

There are various techniques to obtain a controlled release system, one of them is niosomes. The multilamellar or unilamellar structure of niosomes are formed by mixing non-ionic surfactant, cholesterol, and diethyl ether along with subsequent hydration in aqueous media.[10]

Niosomes are better than liposomes and their higher chemical stability of surfactants than phospholipids which are easily hydrolyzed due to the ester bond and cost-effectiveness.[11]

STRUCTURE OF NIOSOME

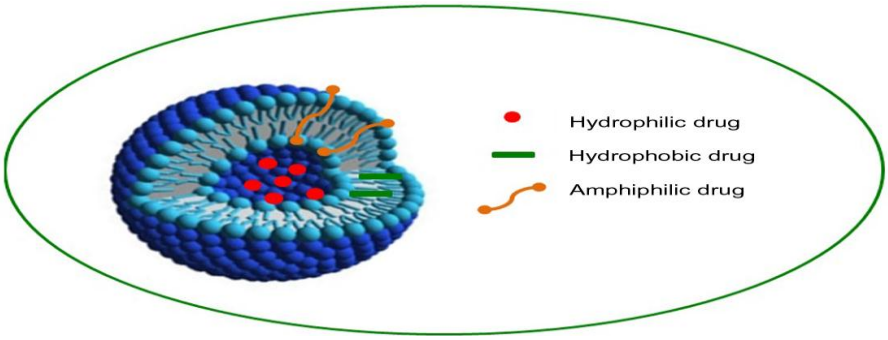

Fig. 1: Structure of noisome.

TYPES OF NIOSOMES

The niosomes are classified as a function of the number of bilayers or as a function of size or as a function of the method of preparation. The various types of niosomes are described below.

1. Multi lamellar vesicles, (MLV, Size=>0.05 μm)
2. Large unilamellar vesicles, (LUV, Size=>0.10 μm).
3. Small unilamellar vesicles, (SUV, Size=0.025-0.05 μm)

1. Multilamellar vesicles (MLV)

It consists of several bilayers surrounding the aqueous lipid compartment separately. The estimated size of these vesicles is 0.5-10 μm diameter. Multilamellar vesicles are the most widely used niosomes. These vesicles are highly suited as a drug carrier for lipophilic compounds.

2. Large unilamellar vesicles (LUV)

Niosomes of this type have a high aqueous or lipid compartment ratio, so that the larger volume of bio-active materials can be entrapped with very economical use of membrane lipids.

3. Small unilamellar vesicles (SUV)

The small uni-lamellar vesicles are mostly prepared from multilamellar vesicles by sonication method, French press extrusion electrostatic stabilization is the inclusion of diacetyl phosphate in 5,6 - carboxyfluorescein loaded Span 60 based niosomes.[12]

COMPOSITION OF NIOSOMES

1. Non-ionic Surfactants: Mainly following types of non-ionic surfactants are used for the formation of niosomes.

a) Alkyl Ethers: For the preparation of niosomes some surfactant-containing chemicals are:

Surfactant-I: is monoalkyl glycerol ether.

Surfactant-II: is diglycerol ether.

Surfactant III: is an ester-linked surfactant. Other than alkyl glycerol, alkyl glycosides, alkyl ethers bearing polyhydroxy head groups which is also used in the formulation of niosome.[13]

b) Alkyl Esters: Sorbitan esters are the most preferred surfactant used for the preparation of niosomes.[14]

c) Alkyl Amides: eg: galactosides and glucosides.[15]

d) Fatty Acid and Amino Acid Compounds: Long-chain fatty acids and amino acid moieties have been used in some niosomes formulation.[16]

2. Cholesterol.

Cholesterol is a steroid derivative, which is mainly used for the formulation of niosomes.[17]

3) Charged Molecule

Eg, dicetyl phosphate, and phosphatidic acid (-ve charge), Stearylamine, and stearyl pyridinium chloride (+ve charge). To prevent aggregation of niosomes these type of charged molecules are used.[18]

METHOD OF PREPARATION

1.Ether injection method

This method provides a means of making niosome by slowly introducing a solution of surfactant dissolved in diethyl ether into warm water maintained the temperature at 60°C. The surfactant mixture in ether is injected through a 14-gauge needle into an aqueous solution of material. Vaporization of ether shows the formation of single-layered vesicles. Depending upon the conditions used the diameter of the vesicle range from 50 to 1000 nm.[19,20]

2. Handshaking method (Thin-film hydrating technique)

Firstly cholesterol and surfactant are dissolved in some organic solvent (like ether, chloroform, benzene, etc). Thereafter, the solvent is evaporated under reduced pressure in a vacuum evaporator in a round bottom flask which then leaves the mixture of solid surfactant and cholesterols on the walls of the round bottom flask. This layer was then rehydrated with an aqueous solution containing the drug with continuous shaking which results in swelling of the surfactant layer. Swelled amphiphiles folds and form vesicles that entrap the drugs. The liquid volume entrapped in vesicles was found to be small. i,e (5-10%).[21-23]

3.Sonication method

In this method, an adequate amount of drug solution in the buffer is added to the surfactant and cholesterol mixture in a 10 ml of glass vial. The mixture is sonicated at 60°C for 3 minutes using a sonicator with a titanium probe to get niosome.[24]

4. Reverse phase evaporation technique

In this method, the mixture of Cholesterol and surfactant are dissolved in a mixture of ether and chloroform. An aqueous phase containing drugs are added to this and the resulting two

phases are sonicated at 4-5°C. The clear gel is formed which further sonicated after the addition of a small amount of phosphate-buffer saline (PBS). The organic phase is removed at 40°C under low pressure. The resulting viscous niosome suspension is diluted with PBS and heated on water bath at 60°C for 10 min to give niosome.[25]

5. Microfluidization

In this method, two fluidized streams move towards the precisely defined micro channel and interact at ultra-high velocities within the interaction chamber. A common approach is arranged in such a way that, the energy supplied to the system remains within the area of niosome formation. The result is a greater uniformity, smaller size, and better reproducibility.[26]

6. Bubble method

It is a novel technique for the preparation of liposome and niosomes without the use of organic solvents. The bubbling unit consists of a round-bottomed flask which consist of three necks positioned in the water bath to control the temperature. Water-cooled reflux and thermometer are positioned in the first and second neck and nitrogen are supply through the third neck. Cholesterol and surfactants are dispersed together in the 7.4 phosphate buffer (pH 7.4) and maintain the temperature at 70°C, than the dispersion mixed for 15 seconds with a high shear homogenizer, and immediately afterward "bubbled" at 70°C using nitrogen gas.[27]

Advantages

- They are osmotically active and stable, and also they increase the stability of the entrapped drug.
- They improve the oral bioavailability of poorly absorbed drugs and enhance skin penetration of drugs.[28]
- Niosome can encapsulate a large number of materials in a small vesicular volume.
- Surfactants used to prepare niosome are biodegradable, biocompatible, and not immunogenic.[29]
- Handling and storage of surfactants does not require any special condition.
- Their surface formation and modification are easy.
- They have high compatibility with biological systems and low toxicity.[30, 31]
- Niosomes are having better patient compliance and better therapeutic effect as well.[32]

APPLICATION OF NIOSOMES

1) Niosomes as drug carriers

Niosome have been used as a carriers for iobitridol, a diagnostic agent used for X-ray imaging. Topical niosome might be serve as a solubilization matrix, as local depot for sustained release of topically active compounds, penetration enhancers, as a rate-limiting membrane barrier for the modulation of systemic absorption of drugs.[33]

1) Drug targeting

One of the most useful aspects of niosomes is its ability to target drugs. Niosomes can be used as a target drugs to the reticuloendothelial system. The reticuloendothelial system preferentially takes up niosome vesicles. A carrier system (such as antibodies) can be attached to niosomes (as immunoglobulin's bind readily to the lipid surface of the niosome) to target them to specific organs.[34]

1) Anti-neoplastic Treatment

Most anti-neoplastic drugs are causes several side effects. Niosome can alter the metabolism, prolong circulation and half-life of the drugs, hence decreasing the side effects of the drugs. Niosomes are decreased the growth rate of tumor and higher plasma levels accompanied by slower elimination.[35]

1) Leishmaniasis

Leishmaniasis is a disease in which a parasite of the genus Leishmania seize the cells of the liver and spleen. The use of niosome in tests conducted showed that it was possible to administer higher levels of the drug without the activate of the side effects, and thus allowed greater efficacy in treatment.[36]

1) Niosomes as carriers for Hemoglobin

Niosomes are used as a carrier for hemoglobin. Niosomal suspension appear a visible spectrum which is superimposable onto that of free hemoglobin. Vesicles are permeable to oxygen and the hemoglobin dissociation curve can be altered comparably to the non-encapsulated hemoglobin.[37]

CONCLUSION

Niosomal drug delivery system is one of the examples of great evolution in the drug delivery technologies. Niosome have been demonstrated to be the promising controlled delivery

systems for the percutaneous administration of both hydrophilic and lipophilic drugs. Niosome appears to be a well-preferred drug delivery system than liposome as niosome being stable and economic. Niosomes also having a great drug delivery potential for targeted delivery of anti-cancer, anti-infective agents. Various kind of drug deliveries can be possible using niosome like targeting, ophthalmic, topical, and parenteral.

Niosomes as a prominent tool for sustained release drug delivery system. Niosomes are novel drug delivery system which offers a large number of advantages over other conventional and vesicular delivery systems there is a lot of scope to encapsulate toxic anti-cancer drugs, anti-viral drugs, anti-infective drugs, anti-AIDS drugs, anti-inflammatory, etc in niosomes. Thus Niosomes presents them as a versatile tool in therapeutics.

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