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REVIEW ON NIOSOMES AS A NOVEL DRUG DELIVERY SYSTEM

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ABSTRACT

Novel drug delivery system also known as new drug delivery system or traditional drug delivery system. Niosomes are a novel drug delivery system. They are non-ionic surfactant. Their salient features such as biodegradability, biocompatibility, chemical stability, low production cost, easy storage the application a number of disease. Niosomes may be unilamellaror multilamellar depending on the method used to prepare them. In which the medication is encapsulated in vesicle. The vesicle is composed of bilayer of non-ionic surfactant active agent. It has application in oral, topical, parentral and novel drug delivery as controlled and targeted delivery niosomes are the mixture of cholesterol and non-ionic surfactant. Niosomal drug delivery system can be considered as an emerging novel drug delivery system. Which consists of microscopic, non-ionic vesicles composed of non-ionic surfactant. These are nontoxic. The article focuses on composition, type of niosomes, preparation method, application salient feature and general characteristics of niosomes.

KEYWORDS: Niosomes, Surfactant, Preparation Method, Evaluation, Biodegradability, Osmotically.

INTRODUCTION

Niosomes are a Novel drug delivery system in which the medication is encapsulated in vesicle. The vesicle is composed of Bilayer of non-ionic surfactant active agent and hence the name niosomes. Structurally niosomes are very small and microscopic size and measure nanometric scale. The particle size ranges from 10 nm-100 nm. They are structurally similar to liposomes.

Niosomes are synthetic microscopic vesicles consisting of an aqueous core enclosed in bilayer consisting of cholesterol and one or more nonionic surfactants.[10]

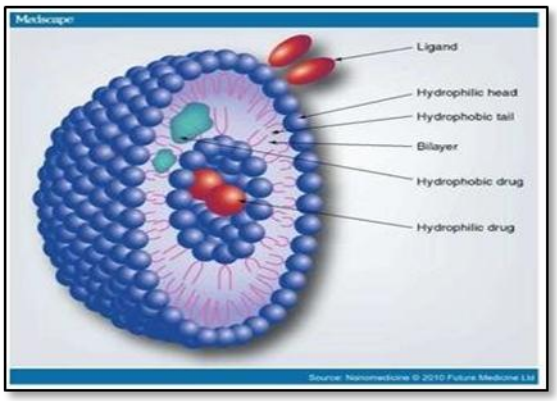


Fig. No. 1

Composition of Niosomes

The two major components used for the preparation of Niosomes are

1) Cholesterol 2) non-ionic Surfactants

1) Cholesterol

Cholesterol is used to provide rigidity and proper shape conformation to the niosomes preparation.

2) non-ionic Surfacts

The role of surfactant play a major role in the formation of noisome.

Ex. Spans (Span 60, 40, 20, 85, 80)

Tweens (Tween 20, 40, 60, 80)

Brijs (Brij 30, 30, 52, 58, 72, 76)[1]

Benifites

1. They are cosmetically active and stable.
2. They increase the stability of the entrapped drug.
3. Handling and storage of surfactants do not require any special condition.[12]
4. The surfactants are Biodegradable, Biocompatible and non-immunogenic.
5. They can be used for oral, parenteral as well as topical.
6. Sustained release of active compounds.

Types of Niosomes

Fig. No. 2

A) Small Unilamellar Vesicles (SUV)[5,4]

The Small Unilamellar Vesicles are mostly prepared from multilamellar vesicles by sonication method.

B) Large Unilamellar Vesicles (LUV)

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

C) Multi Lamellar Vesicles (MLV)

It consists of several bilayers surrounding the aqueous liquid compartment separately multilamellar vesicles are the mostly widely used niosome.

Preparation Methods of Niosomes[1]

A) Small Umilamellar Vesicles (SUV)

1) Sonication Method

In this method aliquot of drug solution in buffer is added to the surfactant/cholesterol mixture in 10 ml glass vial. The mixture is probe sonicated at 60 C for 3 minutes using a sonicator with a titanium probe to yield noisomes.

Preperation Steps

Drug in Biffer + Surfactant/Choleserol in 10 ml.

↓

Above mixture is sonicated for 3 mints at 60 C using titanium probe yielding niosomes.

2) Micro Fluidization

This method used for prepare unilamellar vesicles. It based on submerged jet principle in which two fluidized streams intract at ultra-high velocities.

Preperation Steps

Two Ultra-high Speed jets inside interaction chamber

↓

Impingement of thin layer of liquid in micro channel

↓

Formation of uniform niosomes

B) Large Unilamellar Vesicles (LUV)[5]

1) Ether Injection Method

In this method provides making niosomes by slowly introducing a solution surfactant dissolved in diethyl ether into warm water at 60 C. mixture in either injected through luguage needle into an aqueous solution of material. Diameter of vesicle range from 50 to 100 nm.

Preperation Steps

Surfactant is dissolved in diethy ether

↓

Then injected in warm maintaintained at 60 C throuth 14 gauze needle

↓

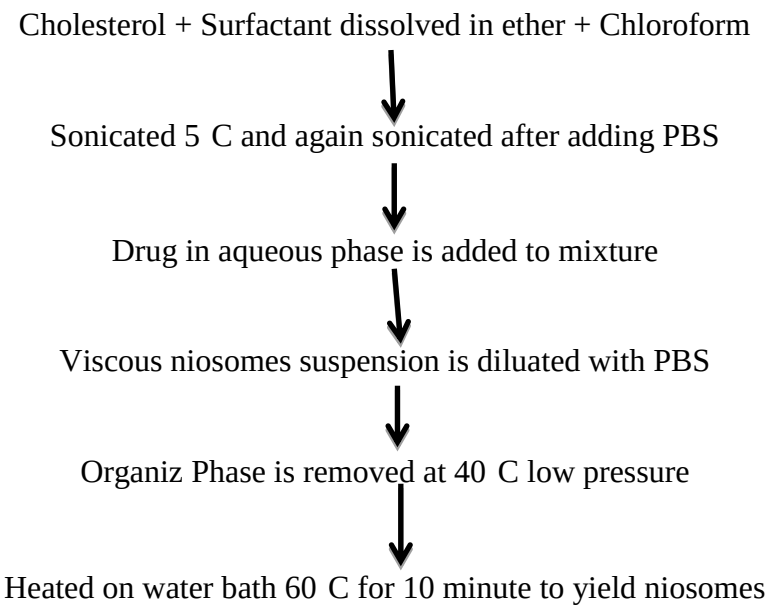
Ether is vaporized to form single layered niosomes.

2) Reverse Phase Evaporation technique

Cholesterol & Surfactant (1:1) are dissolved in ether & chloform. An aqueous phase containing drug added to this & resulting two phases are sonicated at 4-5 C. Clear gel formed is further sonicated added Phosphate buffered in a small amount.

Organic phase removed at 40 C under low pressure vesicles noisome suspension diluated PBS heated water bath 60 C for 10 min to yield niosomes.

Preperation Steps



3) Bubble Method

It is a method for preparation of niosomes without use organic solvent. The bubbling unit consists of round bottom flask with three necks positioned in water bath to control temperature. Water cooled reflux and thermometer is positioned in first and second neck and nitrogen supply through the third neck. Cholesterol and surfacant are dispersed together in this buffer at 70 C the dispersion mixed for is seconds with high shear homogenizer and immediately afterwards bubbled at 70 C using nitrogen gas.

C) Multi Lamellar Vesicles (MLV)

1) Hand Shaking Method

The mixture of vesicles forming ingredients i.e. surfactant, cholesterol dissolved in volatile organic solvent in a round bottom flask solvent removed at room temperature 20 C then the dried surfactants rehydrated with aqueous phase at 0-60 C with gentle agitation & forms typical multilamellar niosomes.

Preperation Steps

Surfactant + Cholesterol + Solvent

↓

Remove organic Solvent Room temperature

↓

Dried Surfactant rehydrated aqueous phase at

↓

Rehydrated to form multilamellar niosomes

2) Trans-membrane ptl gradient drug uptake process

Surfactant & cholesterol dissolved in chloroform, Solvent is evaporated under reduced pressure to form thin film on round bottom flask. The film is with 300 nm citric acid. Multilamellar vesicles are frozen & shared 3 times and later sonicated. To form niosomal suspension aqueous solution contain 10 mg of drug added and vortexes.

Sample of PH then raised to 7.0-7.2 with 1 M bi-sodium Phosphate. This mixture is heated at for 10 minutes to form niosomes.

Preperation Steps

Surfactant + Cholesterol in Chloroform

↓

Solvent is evaporated under reduced pressure

↓

Thin film forms in round bottom flask

↓

Film hydrate with citric acid

↓

Multilamellar vesicles frozen and shared 3 times

↓

Addition aqueous drug solution

↓

PH raised to 7.0-7.2 by 1 M disodium Phosphate

Mixture heated at for 10 minutes to produce niosomes.

Application

Niosomal drug delivery is applicable to many pharmacological agent for their action against various diseases.

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 hemoglobin. Dissociation curve can be altered comparably to the non-capsulated hemoglobin.

2) Leishmaniasis

Leishmaniasis is a disease in which a parasite of the genus leishmania seize the cell of the liver and spleen. The use of noisome in tests conducted showed that is was possible to administrative higher levels of the drug without the activate of side effects and thus allowed greater efficacy in treatment.[2]

3) Niosomes as Drug Carrier

Topical niosomes may serve as solubilization matrix, as a local depot for sustained release of dermal active compounds, it also used as carrier for iobirtidol.

4) Delivery of peptide Drug

Oral peptide drug delivery has long been faced with a challenge of bypassing the enzymes which would breakdown the peptide. Use of niosomes to successfully protect the peptide form gastrointestinal peptide breakdown.[7]

5) In the eye drops

Gentamicin Sulfate, a water-Soluble antibiotics, showed marked variation in the rate of release in its experimental studies.

6) Studying immune response

Due to their, immunological selectivity, low toxicity and greater stability. Niosomes are used for studying the nature of immune response by antigen. Non ionic surfactant vesicles have clearly demonstrated their ability to function as adjuvant parentral administration with a number of different antigen and peptide.[3]

7) Drug targeting

Niosomes possess beneficial ability of targeting site of action. Targeting of drugs to reticulo-endotheial system is successfully done using niosomes. It include the following system.[2,7]

a) To Reticulo Endothelial System (RES)

The vesicles occupy preferentially to the cells of the RES. It is due to circulating serum factors known as opsonins, which mark them for clearance, such localized drug accumulation has been exploited in treatment of animal tumors known to metastasize to the liver and spleen and in parasitic infection of liver.

b) To organ other than reticulo-endothelial System

By use of antibodies carrier system can be directed to specific site in the body. Many cells have the intrinsic ability to recognize the bind particular carbohydrate determinants and this properly can be used to direct carriers system to particular cells.

8) Transdermal Drug Delivery System

Niosomes have application in topical and transdermal products both containing. Hydrophobic & Hydrophobic drugs. Drug encapsulated for topical and transdermal delivery are lidocaine, estradiol, erythromycin, alpha-inferferon.[14]

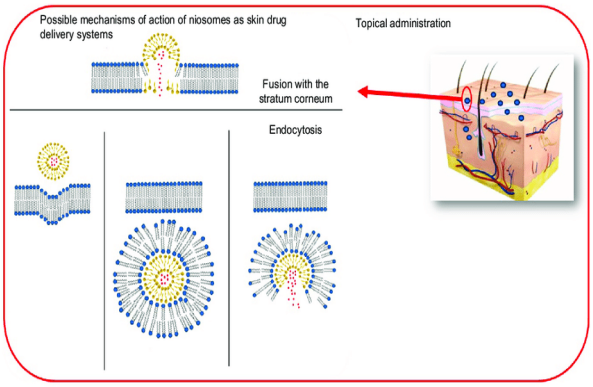


Fig. No. 3

9) Anti-neoplastic treatment

Doxorubicin – The anthracyclic antibiotic, with broad specturum anti-tumor activity, is formulated niosomal preparation for targeted delivery. Most antineoplastic drugs cause serve side effects. Niosomes can alter the metabolism, prolong circulation and half life of drug. Thus decreasing the side effects of drug. Niosomes is decreased rate of proliferation of tumor and higher plasma levels accompanied by slower elimination.

10) Vaccine distribution

For the delivery system of oral vaccines and local vaccination, niosomes are good interest. Niosomes for topical use hepatitis B surface antigen. DNA was prepared by reverse-phase evaporation using span 85 and cholesterol.[16]

11) Sustained release

Sustained release action of niosomes can be applied to drugs with low therapeutic index and low water solubility since those could be maintained in the circulation niosomal encapsulation.[13,15]

12) Localized drug action

Drug delivery through niosomes is one of the approaches to achieve localized drug action, their size and low penetrability through epithelium and connective tissue keeps the drug localized at the site of administration.[6]

Method for evaluation of Niosomes

Evaluation parameter	Method
Morphology	SEM, TEM, freeze fracture technique
Size distribution,	Dynamic light scattering particle
polydispersity index	size analyzer
Viscosity	Ostwald viscometer
Membrane thickness	X-ray scattering analysis
Thermal analysis	DSC
Turbidity	UV-Visible diode array spectrophotometer
Entrapment efficacy	Centrifugation, dialysis, gel chromatography
In-vitro release study	Dialysis membrane
Permeation study	Franz diffusion cell

Chart No. 1

Purpose

Niosomes as novel drug delivery system, can improve the solubility and stability of natural pharmaceutical molecules. They are established to proved the targeting and controlled release of natural pharmaceutical compounds.

Novel drug delivery systems not only reduce the repeated administration to overcome non-compliance but also help to increase the therapeutic value by reducing toxicity and increasing the Bioavailability.

Salient Features of Niosomes

1) Osmotically active and Stable.
2) Niosomes exhibits flexibility in their structural characteristics.
3) Better availability to the particular site by protecting the drug form Biological environment.[8]
4) Perfomance of drug molecules is increased.
5) Entrap solutes in a manner analogous to liposomes.
6) Surfactants used in preparation are Biodegradable, Biocompatible and non-immunogenic.

General Characteristics of Niosomes

- Biocompatible, Biodegradable, Non-toxic, non-immunogenic and non-charcinogenic.
- The ability of nonionic surfactant to form bilayer vesicles.
- Niosomes can be characterized by their size distribution studies.
- High resistance to hydrolytic degradiation.
- The Properties of noisome depends both on composition of the bilayer & on method of their production.

List of drug formulated by niosomes and their route

Table 5: List of Drugs formulated as Niosome-

Routes of administration	Examples of drug
Intravenous route	Doxorubicin, Methotrexate, Sodium stibogluconate, Iopromide, Vincristine, Diclofenac sodium, Flurobiprofen, Centchronam, Indomethacin, Colchicine, Rifampicin, Tretinoin, Transferrin and Glucose ligands, Zidovudine, Insulin, Cisplatin, Amarogentin, Daunorubicin, Amphotericin B, 5-Fluorouracil, Camptothecin, Adriamycin, Cytarabine Hydrochloride
Peroral route	DNA vaccines, Proteins, Peptides, Ergot Alkaloids, Ciprofloxacin, Norfloxacin, Insulin
Transdermal routes	Flburiprofen, Piroxicim, Estradiol, Levonorgestrol, Nimesulide, Dithranol, Ketoconazole, Enoxacin, Ketorolac
Ocular route	Timolol Maleate, Cyclopentolate
Nasal route	Sumatriptan, Influenza Viral Vaccine
Inhalation	A11-trans retinoic acids

Chart No. 2

CONCLUSION

Neosomal drug delivery system is one of example of great evolution in drug delivery system a various type of drug deliveries can be possible using niosomes like targeting, ophthalmic,

topical, parentral etc. Niosomes are osmotically active & chemically stable Niosomes offer various advantage other drug delivery devices and have applicable in Pharmaceutical field. Thus concluded that niosomes are very effective drug delivery tools for incorporation of various therapeutically active agent Niosomes are very useful application for benefit of mankind and they are sed in many pharmacological agent for their action against various disease.

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Diagrams

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2. https://images.app.goo.gl/TwwXMaW1HD5PJVgk9
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Chart

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