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A Brief Review on Niosomes: The Nano Drug Systems

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Abstract: ***Niosomes that are nano drug delivery systems that are proven to very favorable delivery systems for many diseases in recent years. They possess unique features that increase the action of the drug reducing the side effects. They are also found to be more stable agent that prevents the drug from degradation. These are the bilayered vesicles vesicle system that approaches to target site delivery of the drugs where the drug is encapsulated within the bilayer which protects the drug from surrounding environment giving more stability and releasing more drug to the site of action. They have revolutionized the clinical science by their features; they have also been contributed in manufacturing more stable products.***

Keywords: Nano drug delivery, Bilayered vesicles, Encapsulation

1. Introduction

Nano technology like Niosomes, Liposomes, Nanoparticles has revolted the world of clinical science. These drug delivery systems has magnificent properties to avail the drug directly at the site of action which results in increment of the bioavailability, more action and reduction in toxic effects.They have the potential to deliver many kinds of drug and hence are available for different drugs through different routes.

The Niosomes that are made up of non-ionic surfactant and cholesterol are bilayered structures that found to be very stable systems as of liposomes. Drug is encapsulated in the vesicles structure. They are accessible in different sizes at a microscopic scale. They are found to be very non-toxic biodegradable, biocompatible systems.Both hydrophilic and lipophilic drugs entrap either in the aqueous or in the lipid bilayer.These vesicular systems are similar to liposomes that can be used as carriers of amphiphilic and lipophilicdrugs. It is less toxic and improves the therapeutic index of drug by restricting its action to target cells.

2. Structure of Niosomes

Niosomes possess a non- ionic surfactant and cholesterol in its structure and forms a bilayer system.

1) Non-ionic surfactants
Non-ionic surfactants mainly contribute in the formation of Niosomes. Due to non- ionic surfactants Niosomes show more stability in comparison to liposomes. Commonly used some non-ionic surfactants are:

- Tweens (Tween 40, 60, 20, 80)
- Spans (Span 20, 40, 60, 80)
- Polysorbate

2) Cholesterol
Cholesterol is mainly used for providing suitable shape, and stiffness to Niosomes.

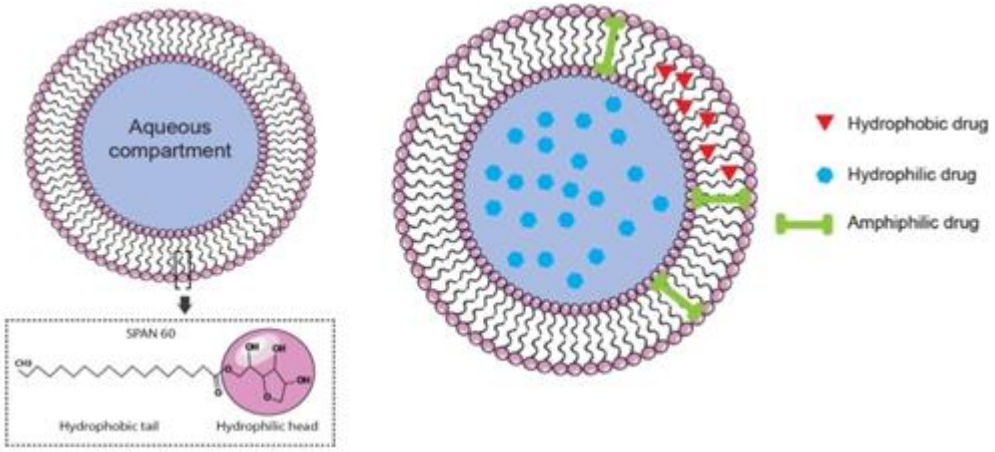

Figure: Niosomes

Advantages

- Delivery at directly site of action
- Sustained release showing more longer action
- Increase in clinical affect
- Provide more stability to drugs
- Double layer offers high protection to the drug

- Suitable for water as well as lipid soluble drugs

Disadvantages
- High technique requirement
- Sometimes mixing of drug occurs during storage
- High cost need for production

Preparation process:
Preparation of the Niosomes involves following processes;

Microfluidization:
This process involves interaction of the drugs and surfectants stream fluidized at super high speed. Principle for this method involves submerged jet principle. Impingement of thin layer along a front is arranged so the Niosomes formed.

Ether injection method:
Ether injection process applying of surfactant solution dissolved in diethyl ether into hot aqueous solution. Surfactants mixture injected slowly with a 14 gauze needle into the aqueous solution. Vaporization of the ether takes place resulting in production of Niosomes vesicles.

Thin film hydration Process:
Cholesterol and non-ionic surfactant mixed together in a round bottom flask. Solvents that are volatile nature (like methanol, chloroform) is added to this mixture. Flash on rotary evaporator for the removal of solvent. Left overnight for the complete removal of organic solvent. Thin film obtained on wall of round bottom flask. Hydrate it with aqueous solution to get vesicles. The evaporation of the solvent can also be done with hand shaking.

The Bubble process:
Bubble process consists of a bubbling unit (a round bottom flask with three necks) kept in water bath for check the temperature. Nitrogen supply is adjusted to one neck, in the second neck thermometer and water cooled reflux in the first neck. Surfactants and cholesterol mixed together and buffer solution added at 60°c, mixed with high shear homogenizer. Yield of Niosomes.

Sonication:
This process include the use of sonicator. The drug solution is added to phosphate buffer and mixed, followed by adding the mixture of cholesterol and suractants. This mixture is probe sonicated at 60°c , formation of unilamalar vesicles.

Reverse Phase Evaporation process
In this process, non-ionic surfectants and cholesterol are mixed and added in a mixture of chloroform and ether solvents. Drug is mixed in water and sonicated. A clear gelling like structure formed further add buffer solution In few amount. Remove organic phase under low pressure. Dense Niosomes formation take place followed by dilution with buffer and heated on water bath to get niosomal vesicles.

Evaluation specifications:
Niosomes are specified for the following:

Vesicles size, shape:
For the vesicle size and shape measurements following microscopic techniques found to be useful
- Phase contrast microscopy
- Transmission electron microscopy (TEM)
- Scanning electron microscopy

Zeta potential:
Zeta potential system refers to the charge measurements employed to check the stability of the Niosomes. Dynamic scattering light method commonly used for detection.

Drug release study:
For the drug delivery systems the drug release is very important parameter to describe the efficiency of drug. In vitro assays are usually performed for the pharmaco profile & their efficacy rate.

Stability study:
This parameter describe the time period for a drug to remains available for the effective use.

Applications of Niosomes:
- **In Topical delivery**
  Niosomes are found to be a very successful in delivering various drugs through the skin tissue. They show an increased permeation and deliver the drug to target site and provide more bioavailability which show a greater therapeutic efficacy. The antihypertensive drugs, antifungal drugs as well as many other drugs are found to deliver via this route which avoids the first pass effect resulting in more concentration of drug in systemic circulation.

- **In Optical drug delivery:**
  They have also shown a increment in delivering of the ophthalmic drugs like gentamycin. They provided a increased entrapment efficiency of the optical drugs increasing their release at target site resulting in more bioavailability.

- **In Anti neoplastic therapy**
  The Niosomes, due to their very small size, high encapsulation efficiency and avail of the drug at the target site has been leading in the effective therapy for carcinogenic cells without harming the neighborhood cellsor tissues. The conventional treatment for cancer has been resulted in more side effects but using Niosomes has shown more effects with reduction in these side effects.

- **In Immune mediated system:**
  They are also showing great potential in immune related diseases. They have the capability to act as immunomodulator as well as in immunodiagnosis.

- **In AIDS treatment:**
  The drugs for AIDS by the traditional treatment have not shown much effect. But using Niosomes delivery systems has resulted in potential increase in therapeutic effect of these drugs.

- **In vaccine and antigen delivery:**
  They have evolved as a successful carriers for the antigens and vaccines also, They are proven to be very helpful in increment in uptake by the cells, their sustained and controlled release which makes them suitable as vaccine and antigen delivery systems.

- **In delivering antibiotics:**
  These vesicular drug systems has also shown the delivery of antibiotics drugs to the target sites. The non-ionic surfactants used in these systems made them very stable and delivering of the antibiotics drug effectively. Also they are showing in excellent delivery of drugs that act against Mycobacterium or Gram negative and positive bacteria making them available for the treatment of Tuberculosis also.

Available marketed products of Niosomes & their routes

Routes	*Drug Products*
IV route	Vincristine, Diclofenac sodium, Methotraxate, Indomethacin, cytabine hydrochloride, insulin, cisplastin, amphotericin-B, adiamysin, tretinoin, colchicine, transferrin, glucose ligands
Ocular route	Cyclopentolate, Timolol maleate
Transdermal route	Ketoconazole, Flurbiprofen, livonorgestrol, nimesulide, estradiol, dithranol
Peroral route	Proteins, peptides, DNa vaccines, alkaloids, ciprofloxacin, norfloxacin, insulin
Nasal route	Sumatriptan, influenza vaccine

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