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An Exhaustive Review on Niosome

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Abstract: ***The Vesicular (niosomes) drug delivery system is novel means to improve the bioavailability of the encapsulated drug along with numerous advantages over conventional drug delivery systems. In this review article, we have made an attempt to incorporate all the basic details of niosome like various methods of preparation, different types of niosomes, factors affecting, characterization of niosomes, their applications, routes of administration as well as the advancements taken place in the field of niosomal research with a literature review of research done in the last decade.***

Keywords: Niosomes, vesicular systems, drug targeting, Novel drug delivery system

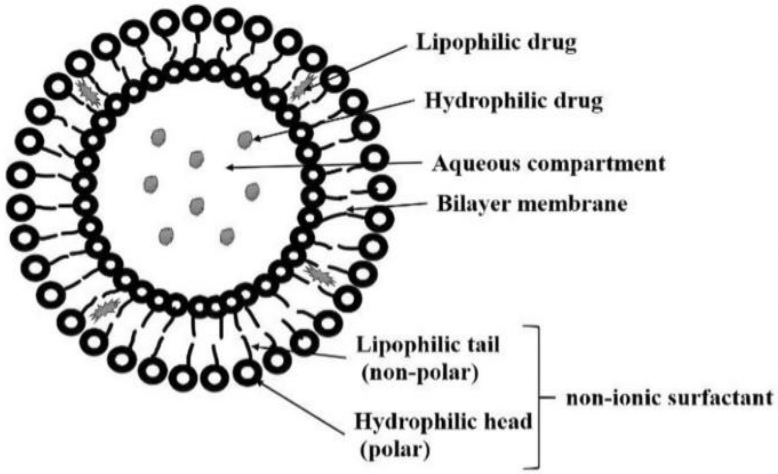
1. Introduction

Niosomes are a novel drug delivery system, in which the medication is encapsulated in a vesicle. Niosomes are non-ionic surfactant based unilamellar or multilamellar bilayer vesicles. The niosomes are very small, and microscopic in size. Their size lies in the nanometric scale. These are formed upon hydration of non-ionic surfactants without incorporation of cholesterol. Both hydrophilic, & lipophilic drugs, can be entrapped either in aqueous layer or in lipid layer. The vesicle is composed of a bilayer of non-ionic surface active agents and hence the name niosomes. Niosomes are formed by non-ionic compounds (surfactant) with a lipophilic tail and hydrophilic head (without charge groups on it), and can selfassemble in aqueous dispersions. Niosome are vesicular, novel drug delivery system, which can be used for the sustained, controlled as well as targeted delivery of drugs.

Structure of Niosomes

These vesicular systems are similar to liposomes that can be used as carriers of amphiphilic and lipophilic drugs.

It is less toxic and improves the therapeutic index of drug by restricting its action to target cells.



Advantages of Niosomes

- Biodegradable, non-immunogenic and biocompatible.
- They are osmotically active and stable.
- They increase the stability of the entrapped drug.
- The characteristic such as size, lamellarity etc. of the vesicle can be varied depending on the requirement.
- Use of niosomes in cosmetics was first done by L`oral as they offered the following advantages.
- The vesicle suspension being water based offers greater patient compliance over oil based systems.
- The vesicles can act as a depot to release the drug slowly and of controlled release.
- Since the structure of the noisome offers place to accommodate hydrophilic, lipophilic as well as amphiphilic drug moieties, they can be used for a varicty of drugs.

Disadvantages of Niosomes

- Aggregation
- Fusion
- Leaking of entrapped drug
- Hydrolysis of encapsulated drugs which limiting the shelf life of the dispersion.

Compostion of Niosomes

The two major components used for the preparation of niosomes are.

1) Cholesterol - Cholesterol is used to provide rigidity and proper shape, conformation to the niosomes preparation.

2) Nonionic surfactant – The role surfactants play a major role in the formation of niosomes. The following non-ionic surfactants are generally used for preparation of niosomes.

Example-pans (span 60, 40, 80)

Tweens (tween 20, 40, 60, 80)
Brijs (brijs 30, 35, 52, 58, 72, 76)

Classification of Niosomes

The various types of niosomes are described below:

1) Multi lamellar vesicles (MLV)
2) Large unilamellar vesicles (LUV)
3) Small unilamellar vesicles (SUV)

Parameters	Muiti Lamellar Vesicles	Small Uniamellar Vesicles	Large Unilamellar Vesicles
Vesicle Size	Greater than 0.05 micrometer	0.025-0.05 micrometer	Greater than 0.10 micrometer
Method of Preparation	Hand Shaking Method	Sonication Method Solvent Dilution Technique	Revers Phase Evaporation Technique

Method of preparation of Niosomes

- Hand Shaking method
- Reverse phase evaporation technique
- Ether Injection method
- Multiple membrane extrusion method
- Sonication method
- Bubble method
- From Proniosomes
- Emulsion method
- Lipid injection method
- Micro fluidization method

Hand shaking method (Thin film hydration technique)

The mixture of vesicles forming ingredients like surfactant and cholesterol are dissolved in a volatile organic solvent (diethyl either, chloroform or methanol) in a round bottom flask. The organic solvent is removed at room temperature using rotary evaporator leaving a thin layer of solid mixture deposited on the wall of the flask. The dried surfactant film can be rehydrated with aqueous phase at with stirring. This process forms typical multilamellar niosomes.

Preparation steps

Surfactant + cholesterol + solvent
↓
Remove organic solvent at Room temperature
↓
Thin layer formed on the Walls of flask
↓
Film can be rehydrated to form multilamellar Niosomes.

Sonication method

In this method mixture of drug solution in buffer, surfactant and cholesterol is sonicated with probe sonicator to yield niosomes.

Preparation steps

Drug in buffer + surfactant/cholesterol
↓
Above mixture is sonicated for 3 mints at 600C using titanium probe yielding noisome

Ether injection method

In ether injection method, the surfactants with additives are dissolved in diethyl ether, and injected slowly through a needle in an aqueous drug solution maintained at a constant temperature, which is above the boiling point of the organic solvent. The organic solvent is evaporated using a rotary evaporator. During the vaporization the formation of single layered vesicles occurs.

Reverse Phase Evaporation Technique

The ingredients are dissolved in a mixture of volatile organic solvents (ether and chloroform). After that an aqueous solution containing drug is added to this mixture and the resulting two phases are sonicated at 4-5°C. Than after the addition of phosphate buffer the clear gel formed is further sonicated. The resulting viscous niosome suspension is diluted with phosphate buffer solution and heated on a water bath to yield niosomes.

Application of Niosome

- Vaccine
- Adjuvants
- As a successful immonomodulater carrier
- Very efficient topical drug delivery
- Cancer therapy
- Peptide drug delivery

Vaccine-The non-ionic surfactant of niosomes are non-toxic and non-antigenic henceforth can be used for successful deliver of drugs through the vaccine. The feasibility to develop a peroral vaccine delivery system based on non-ionic surfactant vesicles (niosomes) was evaluated using BALB/c mice.

Adjuvents-Niosomes as an adjuvant show very efficient drug release with having controlled sustained pattern and

found very is full as an adjuvant so having future scope as adjuvant delivery system.

As a successful immonomodulater carrier-

Very efficient topical carrier-The traditional drugs show less efficiency in drug delivery and release pattern. All show some times irritation in skin. While using niosomes drugs delivery as topical carrier they show very efficient therapy with advantage of controlled release with decrease in irritation. All show it shows delivery of some drugs that when taken from conventional route. for ex. Metoprolol as antihypertensive topical niosoms shows more efficient delivery as compared to conventional method. Clotrimazole as an antifungal (vaginal acne) show more therapeutic effect than traditional method.

Cancer therapy-Cancer has become a global deadly disease Such a way that about 7.6 million death reported in 2008 and based on anticipation, maybe it arrive to 13.1 million death in 2030.

Some traditional cancer therapies such as surgery and chemotherapy have some drawbacks that fail complete treatment of cancer. Also, chemical anticancer drugs can damage healthy cells because of high dose and prolonged usage.

From the beginning and especially recent years, phytochemicals experienced an increasing demand for treatments of diseases. These compounds are bioactive that found in fruits, seed and other medical plants.

Doll and Peto were the first to point out an association between phytochemicals and cancer, suggesting that diets rich in vegetables and fruits reduce the risk of certain cancers.

Thomasset et al. (2006), in a review article, discussed dietary polyphenolic phytochemicals as an anticancer agent. They reported that some phytochemicals such as Genistein, Curcumin, Resveratrol and Epigallocatechin gallate (EGCG) niosomal drug delivery have a promising anticancer effect on prostate and breast cancers.

In another review, Young-Joon Surh et al. (2003) described the mechanism and potential applications of dietary constituents on cancer therapy.

Niosomes (Nio) is an interesting type of colloidal nanocarriers that are made of cholesterol and non-ionic surfactants. Non-ionic surfactants have a hydrophilic head connected to a hydrophobic tail which doesn't have any charge and is relatively non-toxic.

Peptide drug delivery

One of the great challenges in drug delivery is the administration of peptide and protein drugs by the peroral route. There are several possibilities by which the bioavailability of these drugs might be increased. In previous investigations intestinal absorption of 9-desglycinamide 8-arginine vasopressin (DGAVP) administered in bioadhesive drug delivery systems was studied in vitro, in situ and in vivo. Bioadhesive drug delivery systems are assumed to stick to the intestinal mucosa which might result in an increase in absorption of the peptide across the mucosa due to the intimate contact between delivery system and absorbing membrane and/or to a prolonged residence time at the site of absorption. The absorption studies were carried out with microspheres consisting of phydroxyethylmethacrylate with or without bioadhesive polycarbophil (weakly crosslinked polyacrylic acid) coating. Additional experiments showed that the mucoadhesive polymer was able to inhibit the proteolytic degradation of the peptide drug. Another approach to overcome the difficulties in application of peptides along the peroral route might be entrapment of peptides in niosomes, i. e. vesicles prepared mainly from nonionic surfactant. Although several studies have been reported in which liposomes were used as peroral delivery system, only one study has been published in which the application of niosomes was explored. In that study peroral administration of methotrexate led to significantly higher drug levels in brain, liver and plasma than after administration of free drug. Besides some drawbacks in using vesicular systems for peroral application of drugs (e. g. the low chemical and physical stability of the systems) vesicular systems might also have some advantages.

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