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Review on Niosomes-Novel Drug Delivery System

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ABSTRACT :-

Niosome was introduced in 1978 by lancome. (Bangar 2021). This are novel drug delivery system, in which the medications are encapsulated into vesicle. (Islam et.al 2021). Niosomes are formations of vesicles by hydrating the mixture of cholesterol and non-ionic surfactants. Niosomes increase the drug activity as compare to their conventional dosage form of a drug. Niosomes can be used as carrier of amphiphilic and lipophilic drugs. Niosomes may overcome the issues related to instability, fast degradation, low bioavailability, and insolubility of medications. The structure of niosomes either multilamellar or unilamellar, is depends on the method of formulation. To achieve targeted drug delivery, drug binds to receptor site and then we can get the therapeutic action without attaching to other sites to prevent the undesirable or side effect of active pharmaceutical ingredient to the systemic circulation, hence niosomes is a very novel drug delivery system by which we can achieve very safe drug delivery at the site of action needed with high efficacy (Shah et.al 2021). In this review paper we try to compile all the information related with niosomes like introduction, structure, composition advantages, types, disadvantage, preparation methods, factor affecting, evaluation studies, applications of niosomes, , current available marketed formulation , final conclusion and at last future perspective of niosomes. (Bangar 2021).

Keywords:- Niosomes ,Novel drug delivery system

Introduction:-

Nowadays, there is no risk of any on hand drug shipping mannequin to obtain the sitespecific transport with managed launch kinetics of drug in want manner.(2)The existing conventional dosage shape regularly have aspect results and complication due to their largedistribution all through the physique fluids The localization of drug motion in injured tissue is promising way to therapy this tissue (3)(5)Drug focused on can be described as the capability to particularly target the therapeutic agent to the preferred website online of action, with little or no interplay wit nontargeted tissues.(6) (Shah et.al 2021).The reason of drug focused on is to acquire a favored therapeutically response at a selected website besides undesirable interplay at different tissue..In the present day era, quantity of drugcarriers used to be utilized to elevate drug at the particular goal organ/tissue such as immunoglobulins, serum proteins, artificial polymers, liposomes, microspheres, erythrocytes, niosomes and man documented drug transport mannequin to acquire goals. Formation of vesicles organized through the mixing of ldl cholesterol and a non-ionic surfactant.(5) It is an instance for focused and managed release of medicament. Niosomes are favored over liposomes due to the fact the former show off much extra steadiness and economic.(9) They beautify the therapeutic efficacy of the drug molecules by means of delaying the clearance from the circulation and defending from environmentNiosomes are broadly used for focused drug transport system.(11) Paul Ehrlich In 1990 started out the technology of centered drug transport systems. The principal mechanism is that the drug will be centered only to its website online of motion and no longer to the non-targeted cells.(12) Hereby we can minimize the toxicity. The components of niosomes consists of non-ionic surfactants eg. span 60 alongside with cholesterol is brought in order to acquire the steadiness of formulation.(16) (Joy et.al2021).Depending upon the situation used the diameter of vesicle vary from 50 to one thousand nm(9) . (Islam et.al 2021)

The purpose of drug targeting is to obtain a desired therapeutically response at a selected site without unwanted interaction at other tissue..In the modern era, number of drugcarriers was utilized to carry drug at the specific target organ/tissue such as immunoglobulins, serum proteins, synthetic polymers, liposomes, microspheres, erythrocytes, niosomes and many more. Among different carriers niosomes are well organised as well as documented drug delivery model to achieve goals. Formation of vesicles prepared by the mixing of cholesterol and a non-ionic surfactant. It is an example for targeted and controlled release of medicament. Niosomes are preferred over liposomes because the former exhibit much more stability and economic. They enhance the therapeutic efficacy of the drug molecules by delaying the clearance from the circulation and protecting from environment. Niosomes are widely used for targeted drug delivery system . Paul Ehrlich In 1990 started the era of targeted drug delivery systems. The major mechanism is that the drug will be targeted only to its site of action and not to the non-targeted cells. Hereby we can reduce the toxicity. The formulation of niosomes consists of non-ionic surfactants eg. span 60 along with cholesterol is added in order to attain the stability of formulation. (Joy et.al2021).Depending upon the condition used the diameter of vesicle range from 50 to 1000 nm . (Islam et.al 2021) .

Structure of niosomes :-

Niosomes are microscopic lamellar in structure. (Islam et.al 2021)

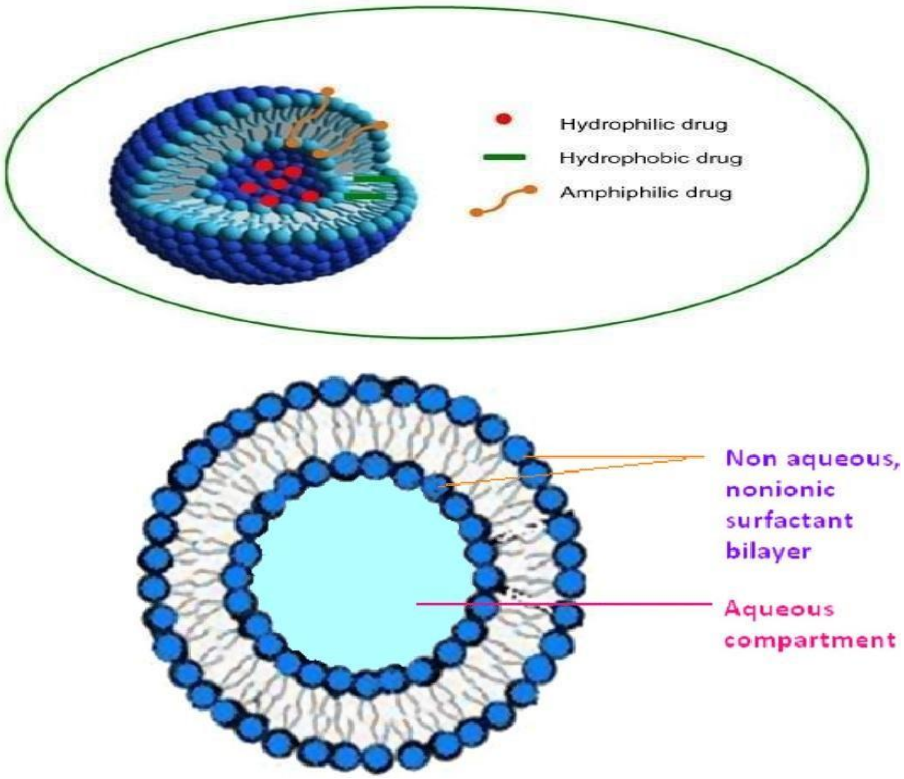


Fig. No.1 Structure Of Niosomes

Niosomes are spherical and consist of microscopic lamellar (unilamellar or multilamellar) structures. Niosomes are made up of a bilayer.(10) Niosomal bilayer made up of non-ionic surfactants. Most of surfactants when Immersed in water there is formation of micellar structures, alternatively some surfactants are structure bilayers which converts into niosomes.(17) (Shahet.al 2021).

Compositionofniosomes:-

In the preparation of niosomes, two components is used:

1. Cholesterol
2. Non-ionic surfactants .

A. Cholesterol have steroid like structure that provides stability and proper shape, as well as configuration to the niosome form.

B. For the Manufacturing of niosomes, non-ionic surfactants are commonly used.

Examples:

a. Tween 40, Tween 20, Tween 60, Tween

b. Span 80, Span 60, Span 40, Span 20, and Span 85.

c. Brij 76, Brij 30, Brij 35, Brij 52, Brij 58, Brij 72 (Medane et.al 2021).

TYPES OF NIOSOMES:-

The niosomes are categorised as a feature of the quantity of bilayers or as a feature of measurement or as a characteristic of the approach of preparation. The quite a number kinds of niosomes are described below. (Islam et.al 2021)

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) (Joy et.al2021)

1.Multilamellar vesicles (MLV)

It consists of a number of bilayers surrounding the aqueous lipid compartment separately. The estimated measurement of these vesicles is 0.5-10 μm diameter. Multilamellar vesicles are most extensively used niosomes. These vesicles are enormously proper as a drug provider for lipophilic compounds Copy Down

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. (Islam et.al 2021)

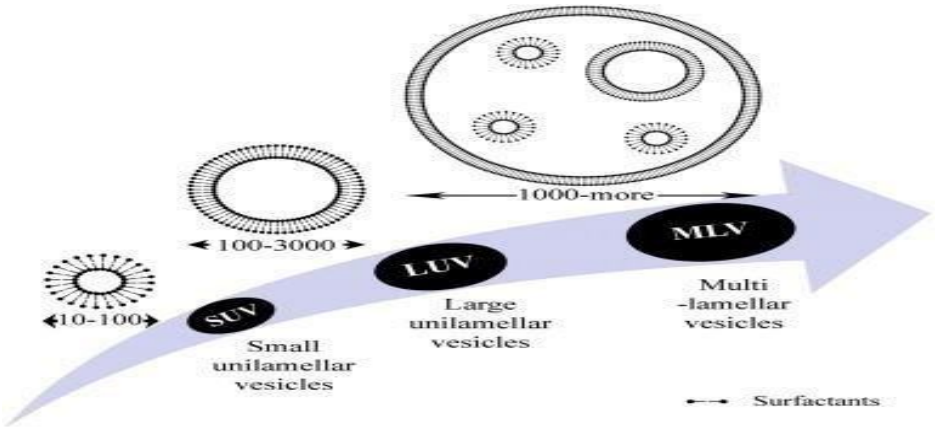


Fig. 2. Small unilamellar Vesicles (SUV)

Advantages of Niosome:-

1)Niosome are used in different routes like oral,parenteral and topical in carriers of drug delivery

2)In niosomes the handling and storage of surfactants required no any special condition

3)They are osmatically active and stable .

4)They can be used in preparation for variety of drugs

5) Enhances the stability of the entrapped drug.I

6) improves the penetration of drug into the skin. (Joy et.al2021)

Disadvantages :-

1)Leaching of drug may occur.

2)Difficult method of preparation.

3)aggregation or fusion. (Joy et.al2021).

Preparation of niosomes :-

Noisome can prepared by using non-ionic surfactants and lipid like cholesterol. Due to the entrapment efficacy of aqueous phase, number of bilayers and permeability of vesicle membranes, vesicle size and its distribution are influenced by the way of preparation. These parameters should be considered when deciding the best staging technique. (Shah et.al 2021)

Methods of preapration :-

Ether Enjection(LUV)

Hand Shaking Method (MLV)

The Bubble method

Reverse phase Evaporation(LUV)

Sonication (SUV)

Multiple membrane extrusion method

Trans membrane pH gradient drug uptake process

Microfludization Method (SUV)

General Method of Preparation:-

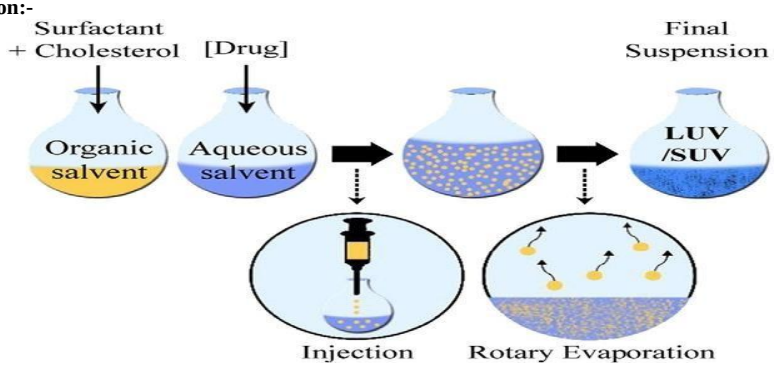


Fig. 3. General Method of Preparation

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. (Islam et.al 2021)

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%). (Islam et.al 2021)

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. (Islam et.al 2021).

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. (Islam et.al 2021)

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 remainswithin the area of niosome formation. The result is a greater uniformity, smaller size, and better reproducibility. (Islam et.al 2021)

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 suppreproducibility 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. (Islam et.al 2021)

7) Multiple Membrane Extrusion Method:-

By evaporating a mixture of surfactant, cholesterol, and dicetyl phosphate in chloroform, thin film is formed. The film is hydrous with an aqueous drug polycarbonate membrane solution, and the resulting suspension is extruded from which up to 8 passages can be mounted in sequence. It's a smart way to keep niosome size under control. (Vinod Mokale (2021)

8) Transmembrane pH Gradient Drug Uptake Process :-

In this step, a surfactant and cholesterol solution is made in chloroform. Similar to the hand shaking process, the solvent is n evaporated under reduced pressure to form a Narrow film on the wall of the round bottom flask. The film is then vortex mixed to hydrate it with citric acid solution. The resulting multilamellar vesicles are then sonicated after going through three freeze-thaw cycles. Aqueous solution containing 10mg/ml of medication is added to the niosomal suspension and vortexes. After adding 1M disodium phosphate to Increase the pH of the sample to 7.0-7.2, the mixture is intense at 140°C for 600 sec. to obtain the niosomes. (Vinod Mokale (2021)

9) Formation of Niosomes From Proniosomes:-

Another way to make niosomes is to use a surfactant to coat a water-soluble carrier like sorbitol.The coating process produces a dry formulation. A thin film of dry surfactant is applied to each water-soluble particle. "Proniosomes" is the name given to this preparation. The addition of aqueous phase at Temperature Gretter, followed by the mean phase transition temperature and brief agitation, is used to identify theniosomes. Niosomes are made from Proniosomes. (Vinod Mokale 2021).

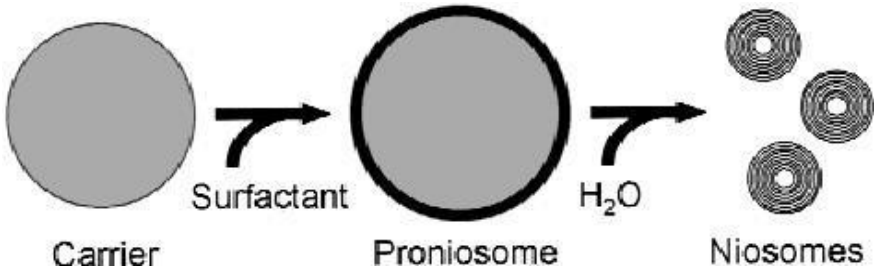


Fig. 4 Formation of Niosomes From Proniosomes

Factors affecting on niosome preparation:-

Drug

Entrapment of drug in niosomes increase vesicle size,probably by interaction of solute with surfactant head group, to increase change of surfactants.

Hydration temperature:

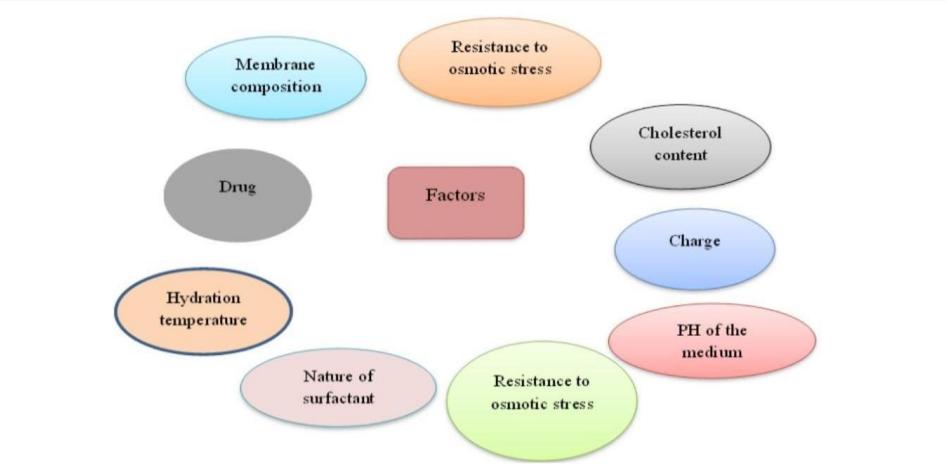
the size and shape of the niosome are affected by the temperature of hydration.

Cholesterol *:-*

Contents of cholesterol increase the entrapment efficiency and hydro dynamic diameter of noisome.

Amount and type :

niosome increase proportionally with increase in the HLB surfactant like span 85 (HLB 1.8) to span 20 (HLB 8.6) because the surfactants free energy decrease with an increase in hydrophobicity of surfactants (Bangar 2021)



Factors Affecting on Stability and Toxicity of Niosome:

Which type of surface active agent we used.

Storage

Temperature

Detergent

Encapsulated drug nature (Bangar 2021).

APPLICATION OF NIOSOME

1)Niosome as drug carriers:

Niosome have been used as a carriers for iobitridol, a diagnostic agent used for X-ray imaging.

Topical niosome may be serve as a solubilization matrix, as nearby depot for sustained launchoftopically energetic compounds, penetration enhancers, as a rate-limiting membrane barrier for themodulation of systemic absorption of drugdrug (Islam et.al 2021)

2)Drug targeting

One of the most beneficial components of niosomes is its capacity to goal drugs. Niosomes can be used as target tablets to the reticuloendothelial system. The reticuloendothelial machine preferentially takes up niosome vesicles. A provider machine (such as antibodies) can be connected to niosomes (as

immunoglobulin‟s bind effectively to the lipid floor of the niosome) to goal them to precise organs.

(Islam et.al 2021)

3)Anti-neoplastic Treatment

Most anti-neoplastic capsules are reasons numerous facet effects. Niosome can alter the metabolism, prolong circulation and half-life of the drugs, consequently lowering the facet outcomes of the drugs. Niosomes are reduced the boom fee of tumor and greater plasma ranges accompanied by way of slower elimination.(Islam et.al 2021)

4) Leishmaniasis

Leishmaniasis is a disorder in which a parasite of the genus Leishmania catch the cells of the liver and spleen. The use of niosome in checks carried out confirmed that it used to be viable to administer greater levels of the drug barring the set off of the facet effects, and as a consequence allowed higher efficacy in treatment.(Islam et.al 2021)

5)Niosomes as carriers for Hemoglobin

Niosomes are used as a provider for hemoglobin. Niosomal suspension show up a seen 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. (Islam

et.al 2021)

Future aspects of niosomes :

1)Oral delivery:

For oral route, the most issues are digestive enzymes and acids in small intestine and stomach, different bioavailability of drug and poor absorption. Following this, to improve or increase bioavailability via new drug delivery system, such as niosomes. Example: improving the bioavailability of Cefdinir via the niosomes are reported (Shah et.al 2021)

2)Transdermal Drug delivery:

Transdermal drug delivery model technique is to protect the drug from the hepatic first pass metabolism as well as provide the controlled drug release in the particular tissue. However, the main disadvantageof this system is skin have many effective barriers which are made up from large protein-lipids. The drug, which have molecular weight, small to penetrate the stratum corneum of skin, can be delivmethod via this method (Shah et.al 2021).

3)Ocular delivery:

Ophthalmic drug delivery have many limitations like impermeability of corneal epithelium and precorneal tear film, which decrease or prevent the absorption of drugs. Nevertheless, niosomal ocular drug delivery is useful because their small size is enough to resist drainage by reflex tearing and eye blinking. Moreover, niosomes are remains on the(Shah et.al 2021)

Marketed formulations of niosome:-

SR.	Brand	Name of the product
1.	Lancôme-Foundation and complexation	Flash Retouch Brush on Concealer
2.	Britney Spears-Curious	Curious coffret: Edp Spray 100ml +Dualended Parfum & pink lipgoss + Body souffle 100 ml
3.	Loris Azzaro - Chrome	Chrome Eau De Toilette Spray 200 ml
4.	Orlane – Lipcolor and Lipstick	Lip Gloss

Conclusion:-

Niosomes have been proposed as a replacement for liposomes. In contrast to liposomes, they have some advantages, such as improved chemical stability, increased purity, and a lower cost. The drugs, metabolism, plasma clearance kinetics, tissue distribution and cellular interaction are all affected by non-ionic surfactant vesicles..Hence by going through all the advancements of niosomes over all other formulations or drug delivery systems, niosomes showing their safety and efficacy as an ideal drug delivery system to achieve better patient compliance.(Vinod Mokale 2021)

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