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Peculiarities of Niosome: A Novel Approach

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HUMAN

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ABSTRACT

Niosomes are nonionic surfactant vesicles obtained by hydration of synthetic nonionic surfactants with or without cholesterol or their lipids. These are liposome-like vesicular systems that can be used as amphiphilic and lipophilic drug carriers. Noisome is a promising tool for drug and nonionic delivery; and niosomes are biodegradable, biocompatible, non-immunogenic and flexible in their structural characterization. Niosomes have been widely evaluated for their controlled release and targeted delivery in the treatment of cancer, viral infections, and other microbial diseases. Niosomes can entrap both hydrophilic and lipophilic drugs and prolong the circulation of the entrapped drug in the body. Encapsulation of a drug in a vesicular system can be predicted to prolong the presence of the drug in the systemic circulation and increase penetration into the target tissue, possibly reducing toxicity if selective uptake can be achieved. This review article focuses on the advantages, Disadvantages, preparation methods, factors affecting, characterizations, in vitro methods, drug release kinetics, and applications of noisome.

INTRODUCTION

AIM

The main aim of development of niosomes is to study peculiarities of niosomal formulation.

LITERATURE SURVEY

1. **V. PolaChandu., *et .al*, (2012):-** Niosomes: a novel drug delivery system: Niosome are non-ionic surfactant vesicles obtained on hydration of synthetic nonionic surfactants, with or without incorporation of cholesterol or their lipids. They are vesicular systems similar to liposomes that can be used as carriers of amphiphilic and lipophilic drugs.

2. **Md. Rageeb Md., *et. al*. (2017)**, Niosomes: a novel trend of drug delivery European journal of biomedical and pharmaceutical science, volume 4: Niosome are promising vehicle for drug delivery.Niosomes are biodegradable, biocompatible non-immunogenic and exhibit flexibility in their structural characterization.

3. **Kaur et al., *et. al* (2018)**, Noisome: A present scenario and future aspects, Journal of Drug Delivery and Therapeutics, Drug targeting is a kind of phenomenon in which drug gets distributed in the body in such a manner that the drug interacts with the target tissue at a cellular or subcellular level to achieve a desired therapeutic response at a desire site without undesirable interactions at other sites. This can be achieved by modern methods of targeting the drug delivery system such as niosomes.

4. **Kumavat., *et.al*,, (2021)**, A review on niosomes : potential vascular drug delivery system , Journal of drug delivery and therapeutics: Niosomes are vesicles composed of nonionic surfactants, which are biodegradable, comparatively non-toxic, stable, economical and effective alternate to liposomes.

5. **Vyas S.P., Khar R, K., (2008)**: Niosomes Targeted and Controlled Drug delivery, Cholesterol presence in membranes brings about significant changes with regard to bilayer stability, fluidity and permeability. It is used as a membrane additive and can be incorporated in high molar ratios.

6. **Madhav. NVS and saini., (2011)**: A, niosomes: a novel drug delivery system. Int. J.rpc.: The chitosancoated niosomal formulation timolol maleate (0.25%) exhibits more effect for

reduction intraocular pressure as compared to a marketed formulation with less chance of cardiovascular side effects.

OBJECTIVE

1. To study niosomal drug delivery system
2. To study types and composition of niosomes.
3. To study method of preparation of niosomes.
4. To study factors affecting niosomal formulation.

Paul Ehrlich, in 1909, initiated the development for targeted delivery when he investigated a drug delivery mechanism that would target directly to diseased cell.The capacity to precisely guide a medicinal agent to the intended site of action with little to no contact with non-target tissue is known as drug targeting. In niosome, the vesicles forming amphiphile is a non-ionic surfactant such as Span-60 which is usually stabilized by addition of cholesterol and small amount of anionic surfactant such as dicetyl phosphate. Non-ionic surfactant vesicles were initially reported in relation to L'Oreal's cosmetic uses. The idea of enclosing the medication within a niosome to enhance its delivery to the right tissue location is generally acknowledged by scientists and scholars. Various types of drug deliveries can be possible using niosomes like targeting, ophthalmic, topical, parental, etc. [(1)]

Non-ionic surfactant vesicles are now widely studied as an alternative to liposomes. Non-ionic surfactant vesicle results from self-assembly of hydrated surfactants of a wide variety of structural types have been found to be useful alternatives to phospholipids. The ultimate identity of any niosomal system and its properties are determined by factors listed in fig.1 It is thus obvious that all these variables must be carefully controlled in the design of a niosomal drug delivery system. [(2)]

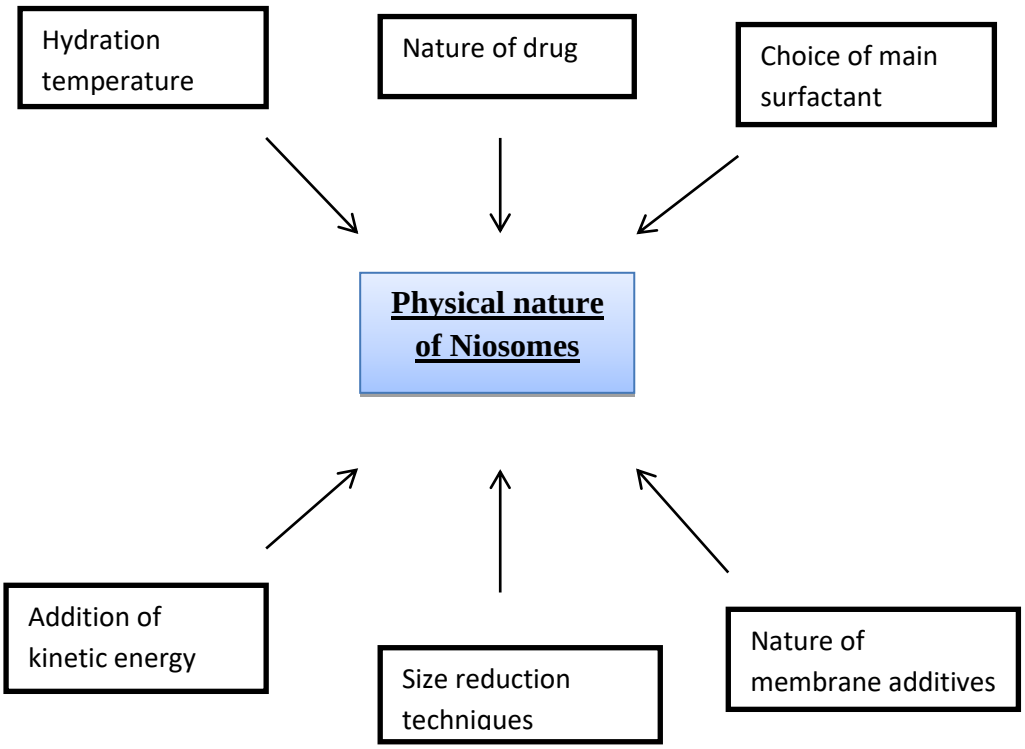

Fig .1: Physical nature of Niosomes

STRUCTURE

An example of a typical niosome vesicle would be an amphiphile that forms vesicles, i.e. a non-ionic surfactant such as Span-60, which is usually stabilized by the addition of cholesterol and a small amount of anionic surfactant such as dicetyl phosphate, which also helps in stabilizing the vesicle.[3][4]

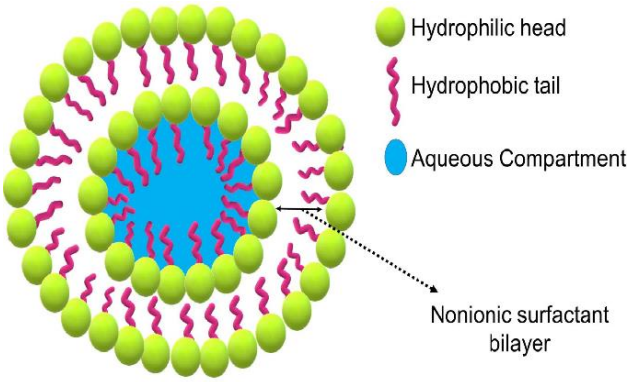

Figure 1:. A typical structure of niosome

Fig. 2 : Typical structure of Niosome

Niosomes are spherical and consist of microscopic lamellar (unilamellar or multilamellar) structures (Fig 1). The bilayer contains nonionic surfactants with or without cholesterol and a

charge inducer. Different surfactants with different combinations and molar ratios are used to form niosomes. Examples of surfactants are alkyl ethers, alkyl glyceryl ethers, sorbitan fatty acid esters, and polyoxyethylene fatty acid esters.

ADVANTAGES OF NIOSOMES ([5]):

• Niosomes are less toxic and compatible because they have no charge.

• They are biodegradable and do not induce immunogenic reactions.

• It can improve the bioavailability of the active drug by increasing the physical and biological stability.

• The use and storage of surfactants do not require special conditions.

• It is very easy to shape and modify their surface.

• It can improve the therapeutic effect of the drug by protecting it from the biological environment and limiting the effect on target cells, thus reducing the elimination of the drug.

• Can improve drug penetration into the skin.

• They increase the stability of trapped drugs.

DISADVANTAGES OF NIOSOMES:

• Physical instability

• Aggregation

• Merger

• Leakage of trapped medication

• Hydrolysis of encapsulated drugs, which limits the shelf life of the dispersion.

COMPOSITION OF NIOSOMES: [5,6]

Two components use in noisome preparation are:

- Cholesterol
- Non-ionic surfactants

A. Cholesterol is a steroid derivative used to provide stiffness and proper shape and conformation of the niosomal form.

B. Nonionic surfactants are often used to prepare niosomes.

Examples:

- Tweens (20, 40, 60, 80)
- Spans (Span 60, 40, 20, 85, 80)
- Brijs (Brij 30, 35, 52, 58, 72, 76)

SALIENT FEATURES OF NIOSOMES: [7]

• Niosomes can trap solutes.

• Niosomes are osmotically active and persistent.

• Niosomes have an infrastructure consisting mostly of hydrophobic and hydrophilic substances together, so they also contain drug atoms with a wide solubility range.

• Targeted therapy can also be carried out with niosomes, in which case the drug is transported specifically to the part of the body where the corrective effect is needed. There, reducing the measurement required to achieve the desired effect.

• They improve the solubility and oral bioavailability of poorly soluble drugs and improve the skin permeability of drugs when applied topically.

• The structural properties of niosomes (composition, fluidity, and size) are flexible and can be designed according to the desired situation.

• Niosomes can enhance the activity of drug molecules.

• Better availability to a certain area than only by protecting the drug from the biological environment.

• Niosomes increase the stability of an entrapped drug.

TYPES OF NIOSOMES :[8]

Many types of niosomes have been reported in the literature. They can be classified according to the size of the niosomes (SUV, LUV, etc.) or according to the number of bilayers (SUV, MLV, etc.). Based on these factors, niosomes can be divided into categories described in the following subsections:

- ❖ Multilamellar vesicles niosomes (MLV)
- ❖ Large unilamellar vesicles niosomes (LUV)
- ❖ Small unilamellar niosomes (SUV)
- ❖ Bola niosomes
- ❖ Pro-niosomes

1 MULTILAMELLAR VESICLES (MLV):

MLV consists of several bilayers that separately surround the lipid water compartment. The approximate sizes of these bubbles vary from 0.5 to 10 μm (Figure 2). These niosomes are most widely used due to their easy preparation and mechanical stability during long-term storage. These vesicles are highly suited as drug carriers for lipophilic compounds. Three different surfactants with different physical states—that is, Span 60 (solid), Brij 52 (semisolid) and Brij 92 (liquid state)—were employed to form stable niosomal suspensions in the presence of Cholesterol.

2 LARGE UNILAMELLAR VESICLES (LUV):

This type of niosome (100–3000 nm) has a high aqueous phase-to-surfactants compartment ratio; accordingly the bioactive material can be entrapped with a very economical use of membrane surfactants (Fig. 2). A Span 20-based niosome was prepared by a membrane hydration method and loaded with Newcastle disease vaccine. Newcastle disease is a contagious bird disease which affecting many domestic and wild avian species.

3 SMALL UNILAMELLAR VESICLES (SUV):

Generally, small unilamellar vesicles (SUV) are produced from multilamellar vesicles (MLV) by various methods, such as sonication, extrusion under high pressure, and high-pressure homogenization. The approx sizes of small unilamellar vesicles are 10-100 nm. There are three disadvantages of SUVs:

(1) They are highly unstable thermodynamically,

(2) They tend to aggregate

(3) The amount of loaded hydrophilic drugs in this group is low. (Fig. 2)

4 BOLA NIOSOMETS: Bola surfactant has two hydrophilic ends connected by one or two long lipophilic spacers.

5 PRONIOSOMES: Proniosomes obtained from a water-soluble carrier are coated with a thin film of dry nonionic surfactant. Carriers must be safe and non-toxic, free-flowing, poorly soluble in the loaded mixing solution, and have good water solubility for ease of use. hydration It contains maltodextrin, sorbitol, mannitol, glucose monohydrate, and lactose monohydrate.

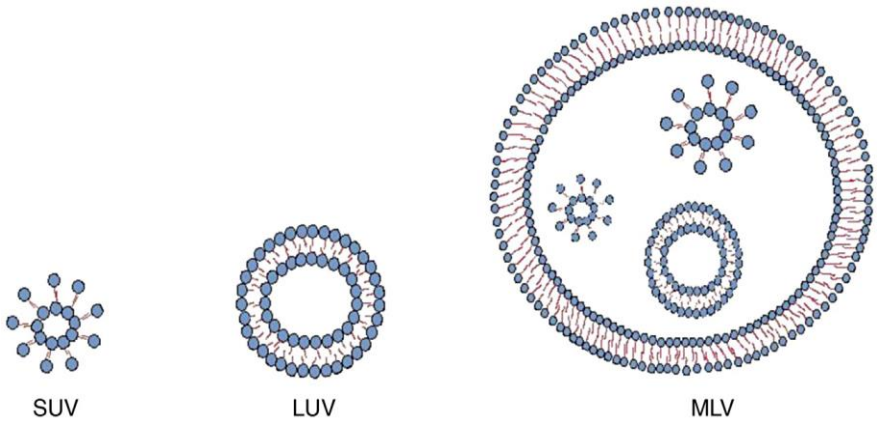

Fig. 3.: Structure of SUV, LUV, and MLV

PREPARATION METHODS OF NIOSOMES: [1] [4] [11-17]

Production methods should be chosen according to the use of niosomes, because production methods affect the number, size, size distribution and blocking efficiency of the aqueous phase and the membrane permeability of the vesicles.

- Ether injection method
- Hand shaking or thin film hydration technique
- Sonication
- Microfluidization technique
- Reverse phase evaporation technique
- Trans membrane pH gradient drug uptake process
- Bubble method

1. ETHER INJECTION METHOD:

This method provides a way to prepare niosomes by slowly adding a surfactant dissolved in diethyl ether to heating water maintained at 60 °C. A mixture of surfactant in ether is injected through a 14 gauge needle into the aqueous solution of the material. Vaporization of ether leads to formation of single layered vesicles. Depending upon the conditions used
the diameter of the bubble is 50-1000 nm.

PREPARATION STEPS:

Surfactant is dissolved in diethyl ether.

↓

Then injected in warm water maintained at 60^{o}C through a 14-gauze needle.

↓

Ether is vaporized to form single layered niosomes.

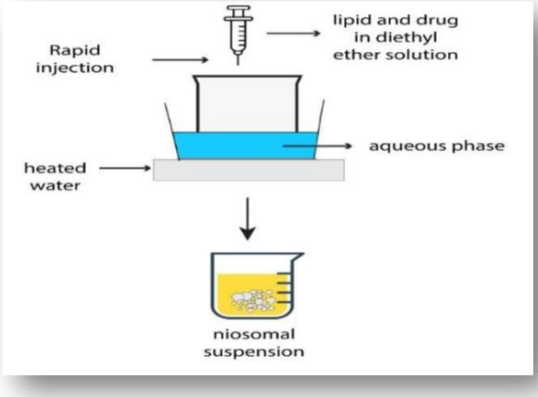

Fig. 4: Illustrative depiction of the preparation of niosomes with the ether injection

2. HANDSHAKING METHOD (THIN FILM HYDRATION TECHNIQUE):

The mixture of vesicles forming ingredients like surfactant and cholesterol are dissolved in a volatile organic solvent (diethylether, chloroform or methanol) in a round bottom flask. The organic solvent is removed at room temperature (20°C) 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 0-60°C with gentle agitation. This process forms typical multilamellar niosomes. (Fig. 4)

PREPARATION STEP:

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.

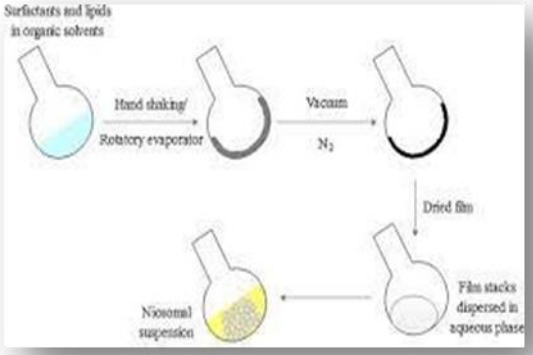

Fig. 5: Illustrative depiction of the preparation of niosomes with the Handshaking method

3. SONICATION TECHNIQUE:

In this method, an aliquot of the drug solution in buffer is transferred to the surfactant/cholesterol mixture in a glass vial. The mixture is sonicated by using probe sonicator at 60°C for 3 minutes titanium probe is used to yield the niosomes.

PREPARATION STEP:

Drug in buffer + surfactant/cholesterol in 10 ml

↓

The above mixture is sonicated for 3 minutes at 60 oC using titanium probe yielding niosomes.

4. MICROFLUIDIZATION TECHNIQUE:

Microfluidization is a new technique used to produce unilamellar bubbles with a defined size distribution. This method is based on the principle of an underwater jet, where two streams of boiling water interact at a very high speed in well-defined microchannels inside a mutual chamber. The collision of the thin liquid sheet along the common front is arranged so that the energy added to the system remains in the region of niosomeformation.The result is greater uniformity, smaller size and better reproducibility of the formed niosomes. (Fig. 5)

PREPARATION STEP:

Two ultra-high speed jets inside interaction chamber

↓

Collision of a thin liquid layer in microchannels

↓

Formation of uniform Niosomes.

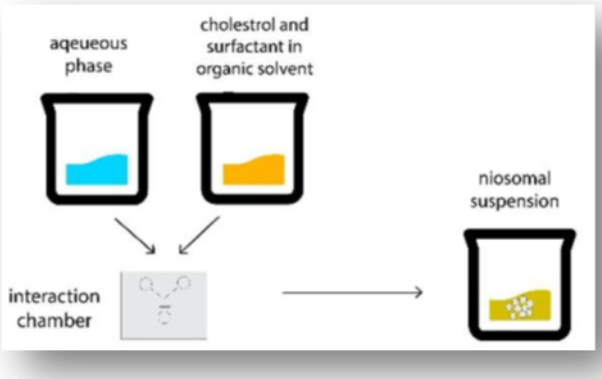

Fig. 6: Illustrative depiction of the preparation of niosomes with the microfluidization technique

5. REVERSE PHASE EVAPORATION TECHNIQUE:

Cholesterol and surfactant (1:1) are dissolved in a mixture of ether and chloroform. An aqueous phase containing drug is added to this and the resulting two phases are sonicated at 485°C.

The resulting clear gel is further sonicated after adding a small amount of phosphate-buffered saline (PBS). The organic phase is removed at 40 °C under reduced pressure. The resulting viscous noisome suspension is diluted with PBS and heated on a water bath at 60°C for 10 min to yield niosomes. (Fig. 6)

PREPARATION STEP:

Cholesterol + surfactant dissolved in ether + chloroform.

↓

Sonicate at 5°C and sonicate again after adding PBS.

↓

The drug in the aqueous phase is added to the above mixture.

↓

Viscous niosomes suspension is diluted with PBS.

↓

The organic phase is removed at 40 ^{o} C under reduced pressure.

↓

Heated on a water bath for 60^{o}C for 10 mints to yield niosomes.

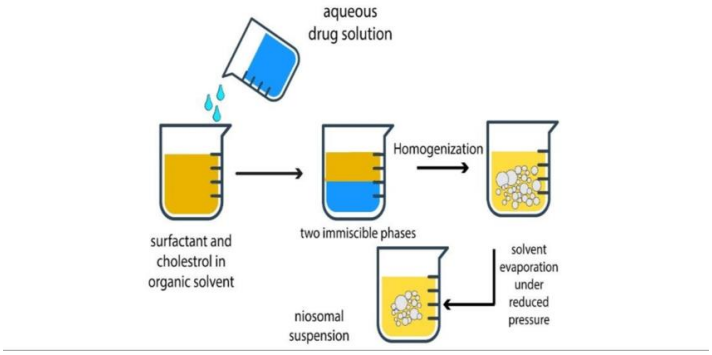

Fig. 7 Illustrative depiction of the preparation of niosomes with the Reverse phase evaporation technique

6. TRANS MEMBRANE pH GRADIENT (inside acid) DRUG UPTAKE PROCESS:

Surfactant and cholesterol are dissolved in chloroform. The solvent is then evaporated under reduced pressure to form a thin film on the round bottom flask. The solid is hydrated with 300 mM citric acid (PH 4.00 with tip mixing. The multilamellar vesicles are frozen and disrupted 3 times and then sonicated. An aqueous solution containing 10 mg ml of the drug is added to this niosomal suspension and vortexed mixing. Multilamellar vesicles are frozen and split three times and then sonicated..To this niosomal suspension. Aqueous solution 10 mg/ ml of drug is added and vortexed. The PH of the sample is then raised to 7.087.2 with 1M disodium phosphate. This mixture is later heated at 60°c for 10 minutes so give niosomes.

PREPARATION STEP:

Surfactant + cholesterol in chloroform

↓

The solvent is evaporated under reduced pressure

↓

A thin film is deposited on the walls of the RBF

↓

Hydrated with citric acid by vortex mixing

↓

3 cycles of freezing and thawing then sonication

↓

Addition of aqueous drug solution and vortoxing

↓

pH raised to 7.087.2 by 1M disodium phosphate

↓

RBF as bubbling unit with three necks in water bath

↓

Reflux, thermometer and nitrogen supply by three necks

↓

Cholesterol + surfactant dispersed in buffer pH 7.4 at 70^{o}C

↓

The above dispersion is homogenized for 15 seconds and then bubbled with nitrogen gas at 70^{o}c

↓

To get niosomes.

7. BUBBLE METHOD:

It is a new method for one-step preparation of liposomes and niosomes without organic solvents. The bubbling unit consists of round8bottomed flask with three necks positioned in water bath to control the temperature. Water8cooled reflux and thermometer is positioned in the first and second neck and nitrogen supply through the third neck. Cholesterol and surfactant are dispersed together in this buffer (PH 7.4) at 70°C, the dispersion is mixed for 15 seconds with a high shear and immediately "bubbled" at 70°C using nitrogen gas.

SEPARATION OF UNENTRAPPED DRUG [1]

Removal of encapsulated solute from the vesicles can be accomplished by a variety of techniques, including:

1. DIALYSIS

An aqueous niosome dispersion is dialyzed in a dialysis tube against a suitable solubilizing medium at room temperature. The culture medium is sampled at appropriate intervals, centrifuged and the drug content is analyzed by an appropriate method (UV spectroscopy, HPLC, etc.).

2. GEL FILTRATION

The retained drug is removed by gel filtration of the niosomal dispersion through a Sephadex-G-50 column and eluted with a suitable mobile phase and analyzed by suitable analytical methods**.**

3.CENTRIFUGATION

The proniosome derived niosomal suspension is centrifuged and the supernatant is separated. The pellet is washed and then resuspended to obtain a niosome suspension in which the unentrapped drug.

FACTORS INFLUENCING LIPOSOMAL FORMULATIONS: [4][18-20]

- **Cholesterol**

Cholesterol in niosomes increases its hydrodynamic diameter and blocking capacity. This affects the membrane properties of niosomes in the same way as biological membrane properties. This reduces the flexibility of the membrane and also affects the penetration of the drug through it. The amount of cholesterol used depends on the HLB value of the surfactant.

- **Nature of Surfactant**:

Ether-type surfactants with a single alkyl hydrophobic tail are more harmful than a dialkyl ether chain. Ester-based surfactants are chemically less stable than ether-type surfactants because the ester bond is particularly sensitive to degradation by esterases into fatty acids and triglycerides. An increase in the HLB value of the surfactant leads to an improvement in the

average size of the niosomes, which is due to an increase in the hydrophobicity of the surfactant due to a decrease in the surface free energy.

- **Surfactant composition**:

This composition, which can be related to important loading variables, affects the shape of the surfactant-produced bubble. Essential packing variables of supported chemical agents, and vesicle geometry is expected to evolve.[22]

- **Hydration temperature**:

Hydration temperature affects the size and shape of niosomes. The hydration temperature must be higher than the liquid phase transition temperature of the gel. Fluctuation in temperature affects the accumulation of surfactants in bubbles and changes in the form of the bubbles. The volume and time of the hydration medium also affect the modification. Improper hydration time, temperature, and hydration volume, which can cause problems in niosome formation, such as creating brittle niosomes or causing drug leakage.

- **Hydration time:**

Methylene blue niosomes are prepared using a thin film hydration technique and the vesicles are probed to ensure size uniformity. The effects of hydration time and hydration volume on blocking ability and bubble size are investigated. This suggested that a short hydration time produces larger bubbles and less drug entrapment, and a longer hydration time produces small-sized bubbles.

- **Charge**

Charge of the vesicle improves the inter lamellar distance between successive bilayers in multilamellar vesicle structure and it also improves the overall entrapped volume and stability of niosomes.

- **Resistance to osmotic stress**

Addition of hypertonic saline to the niosome suspension results in a decrease in diameter. In hypotonic saline, release is initially slow and mild swelling of the vesicles is likely due to inhibition of fluid elution from the vesicles, followed by a more rapid release that maybe due to mechanical loosening of vesicles structure below osmotic stress.

- **Nature of encapsulated drug**

Niosomal formulation is influenced by the nature of the drug being encapsulated. The interaction of the surfactant head groups leads to the trapping of the drug in the vesicles and causes an increase in charge. The formation of charge creates mutual repulsion of the surfactant bilayer and therefore will raise vesicle size. The HLB of the drug affects the degree of capture in the same way.

- **Membrane composition**:

Stabilization of niosomes can be achieved by adding completely different additives to the surfactant mixture. The main drawback of niosomes formulation is the leakage of drug from the vesicles which might be controlled by the addition of cholesterol. Cholesterol confers higher rigidity to the membrane and therefore leakage of the drug is reduced.

CHARACTERIZATION OF NIOSOMES: [5][21-22]

1) **Bilayer Rigidity and Homogeneity:** The biodistribution and biodegradation of niosomes are influenced by the rigidity of the bilayer. In homogeneity can occur both within niosome structures and between niosomes in dispersion and could be identified via. p-NMR, Differential scanning calorimetry (DSC) and Fourier transform-infra red spectroscopy (FT-IR) techniques.

2) **Size and Shape:** Various methods is used for the determination of mean diameter like as laser light scattering method besides it also determines by electron microscopy, molecular sieve chromatography, photon correlation microscopy, optical microscopy.

3) **Stability Study:** Niosomal formulations are subject to stability studies by storing at 4°C, 25°C, and 37°C in thermostatic oven for the period of three months. After one month, drug content of all the formulations are checked by entrapping efficiency parameter.

4) ***In-vitro* Release:** In-vitro release rate study carried out by the use of

1. Dialysis Tubing,

2. Reverse dialysis and

3. Franz diffusion cell.

a. Dialysis Tubing: A dialysis sac is washed with distilled water. The prepared vesicle suspension is pipetted into a bag made up of the tubing dialysis and after that the bag is sealed. Then the bag containing the vesicles is placed in 200 ml of buffer solution in a 250 ml beaker with constant shaking at 25°C. At various time intervals, the buffer is an analysis of the drug content of an appropriate assay method.

b. Reverse Dialysis: A number of small dialysis as containing 1ml of dissolution medium is placed in proniosomes. The proniosomes are then changed into the dissolution medium. The direct dilution of the proniosomes is possible with this method and the rapid release cannot be quantified by using this method.

c. Franz Diffusion Cell: The in vitro diffusion studies can be performed by using Franz diffusion cell. Proniosomes is placed in the donor chamber of a Franz diffusion cell fitted with cellophane membrane. The proniosomes is then dialyzed against a suitable dissolution medium at room temperature; the samples are withdrawn from the medium at suitable intervals and analyze for drug content using suitable method such as U.V spectroscopy, HPLC, etc. the maintenance of sink condition is essential. [23-24]

5) **Scanning Electron Microscopy:** The niosomes were observed under a scanning electron microscope (SEM) (JSM 6100 JEOL, Tokyo, Japan). They were attached directly to the SEM sample with double-sided tape and covered with a 200-nm-thick gold film under a reduced pressure of 0.001 mmHg. Photographs were taken at suitable magnification.

6) **Vesicle Charge:** The vesicle surface charge can play an important role in the behavior of niosomes in vivo and in vitro. Charged niosomes are more stable against aggregation and fusion then unchanged vesicles. To estimate the surface potential, the zeta potential of individual niosomes can be measured by microelectrophoresis. An alternative approach is the use of pH-sensitive fluorophores. More recently, dynamic light scattering have been used to measure the zeta potential of niosomes.

APPLICATIONS OF NIOSOMES: [8]

1) **Niosomes as Drug Carriers:** Iobitridol, an X-ray diagnostic agent, has also been used as a carrier in niosomes. Topical niosomes can act as a solubilizing matrix, a local depot for the sustained release of active agents through the skin, penetrating agents, or a rate-limiting membrane barrier to modulate the systemic absorption of drugs. Drug targeting is essential aspect of drug as it is their ability to target drugs. Niosomes can be used to deliver drugs to

the reticuloendothelial system. Niosomal vesicles mainly occupy the reticuloendothelial system (RES). Niosome uptake is regulated by circulating serum factors called opsonins. These opsonins mark the niosome for clearance. Such localization of drugs is utilized to treat tumors in animals known to metastasize to the liver and spleen. This localization of drugs can also be used to treat parasitic infections of the liver. Niosomes can also be used to target drugs to organs other than the RES. A carrier system (such as antibodies) can be attached to niosomes (as immunoglobulins readily bind to the lipid surface of the niosomes) to target specific organs.

2) **Antitumor therapy:** Most antitumor drugs cause serious side effects. Niosomes can alter metabolism; prolongs the blood circulation and half-life of the drug, which reduces the side effects of the drugs. Niosomes have a reduced rate of tumor proliferation and higher plasma concentrations with slower elimination.

3) **Leishmania**: Leishmaniasis is a disease in which a parasite belonging to the Leishmania family invades the cells of the liver and spleen. The use of niosomes in the conducted tests showed that it was possible to administer the drug in larger quantities without causing side effects, which made it possible to increase the effectiveness of the treatment. Administration of peptide drugs Oral administration of peptide drugs has long been a challenge to avoid peptide-degrading enzymes. The use of niosomes to successfully protect peptides from peptide degradation in the gastrointestinal tract is under investigation. An in vitro study performed by oral encapsulation of a vasopressin derivative into niosomes showed that entrapment of the drug significantly increased the stability of the peptide. Use in immune response studies Due to immunological selectivity, low toxicity and better stability; niosomes are used to study the nature of the immune response elicited by antigens. Nonionic surfactant vesicles have demonstrated their ability to function as adjuvants following parenteral administration of several different antigens and peptides.

4) **Niosome as a carrier for haemoglobin [27]:** Niosomal suspension shows a visible spectrum super imposable onto that of free hemoglobin so can be used as a carrier for hemoglobin. Vesicles are also permeable to oxygen and hemoglobin dissociation curve can be modified similarly to non-encapsulated hemoglobin.

5) **Other applications** [4-6]: a) Sustained release the long-acting effect of niosomes can be applied to drugs with a low therapeutic index and low water solubility, because they can be retained in the bloodstream through niosome encapsulation. b) Local drug effect Drug

delivery through niosomes is one of the approaches to achieve a local drug effect, because their size and low penetration through the epithelium and connective tissue keep the drug in place at the site of administration.

PRODUCT MARKETING:

Lancome has launched various antiaging products based on niosome formulations. L'Oreal is also researching anti-aging cosmetics. The preparation of niosomes on the market is Lancome. [1]

CONCLUSION

This report concludes that, niosomes are nonionic surfactant vesicles obtained by hydration of synthetic nonionic surfactants with or without cholesterol or their lipids. These are liposome-like vesicular systems that can be used as amphiphilic and lipophilic drug carriers. Noisome is a promising tool for drug and nonionic delivery; and niosomes are biodegradable, biocompatible, non-immunogenic and flexible in their structural characterization. Niosomes have been widely evaluated for their controlled release and targeted delivery in the treatment of cancer, viral infections, and other microbial diseases. Encapsulation of a drug in a vesicular system can be predicted to prolong the presence of the drug in the systemic circulation and increase penetration into the target tissue, possibly reducing toxicity if selective uptake can be achieved.

FUTURE PROSPECTS

- Scope to encapsulate toxic drug
- Safer than ionic drug carrier
- Better bioavailability
- Target specificity

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