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Niosomes: Novel Drug Delivery Systems

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Abstract

The administration of medications to specific targets with minimal affinity to other organs is a challenge during the treatment of disease conditions. Novel drug delivery systems enable localization of drugs to their site of action. These targeted drug delivery systems use various carriers, such as serum proteins, liposomes, synthetic polymers, and microspheres. Niosomes are a type of drug delivery system that has a bilayer structure made of non-ionicsurfactants. Niosomes are amphiphilic; hence, they can encapsulate both lipophilic and lipophobic drugs and increase their bioavailability. Current work describes the structure, various methods of preparation and applications of niosomes.

Keywords: Niosomes, Novel Drug Delivery System, Nonionic Surfactants, Amphiphilic.

1. INTRODUCTION

As of late, vesicles have turned out to be the vehicle of choice in drug delivery. Lipid vesicles play an important role in improving bioavailability for existing drugs that are mainly available in conventional dosage forms. It was found to be of value in immunology, membrane biology, diagnostic techniques, and most recently, genetic engineering. Vesicles can play a critical role in modeling biological membranes, and in the transport and targeting of active agents. Conventional chemotherapy for the treatment of intracellular infections is not effective; because of the constrained penetration of medications into cells. This overcomes by the utilization of vesicular drug delivery systems. Encapsulation of a medication in vesicular structures is expected to predict the presence of the medication in systemic circulation, and the possible decrease in the toxicity if specific take-up is accomplished. The phagocytic uptake of the drug-loaded vesicular delivery system provides a proficient technique for the delivery of drugs directly to the site of infection, prompting a decrease in medication toxicity with no unfavorable effects. Vesicular drug delivery diminishes the cost of treatment by enhanced bioavailability of solution, particularly in the event of inadequately dissolvable medications. They can consolidate both hydrophilic and lipophilic medications. Vesicular drug delivery systems delay drug elimination of rapidly metabolized drugs, and function as sustained release systems. This system solves the issues of medication insolubility, instability, and rapid degradation. Thus, various vesicular delivery systems, such as liposomes, niosomes, developed [1]. Niosomes are novel drug delivery systems; in which the medication is encapsulated in a vesicle. The vesicle is made of a player of non-ionic surface active agents and subsequently the name niosomes. The niosomes are very small, where their size lies in the nanometric scale [1]. Although structurally similar to liposomes, they offer several advantages over them. Niosomes have been shown to greatly increase transdermal drug delivery and also they can be used in targeted drug delivery [2]. Niosomes are nonionic surfactant vesicles obtained on the hydration of manufactured nonionic surfactants, with or without joining of

cholesterol or other lipids. They are vesicular systems like liposomes that can be used as carriers of amphiphilic and lipophilic medications. Niosomes are promising vehicles for drug delivery and; being non-ionic, they are less dangerous and enhance the therapeutic index of drugs by confining their activity to target cells [2].

1.1 Components of Niosomes

Niosomes Mainly Contain Following Components:

1.1.1 Non-Ionic Surfactants

The non-ionic surfactants situate themselves in bilayer lattices where the polar or hydrophilic heads adjust themselves, confronting a watery mass (media) while the hydrophobic head or hydrocarbon portions align in such a way that the interaction with the aqueous media would be limited. To achieve thermodynamic stability, each bilayer creases over itself as consistent film i.e. shapes vesicles so that hydrocarbon/water interface remains no more exposed [3].The following types of non-ionic surfactants are utilized for the formation of niosomes:

Alkyl Ethers: L'Oreal described some surfactants for the preparation of niosomes containing drugsasC16 mono alkyl glycerol ether with average of three glycerol units, with molecular weight of 473. Diglycerol ether (MW 972) is another surfactant with an average of the seven glycerol units. An ester linked surfactant (MW 393) is another example [3]. Other than alkyl glycerol, alkyl glycosides and alkyl ethers bearing poly hydroxyl head groups are also utilized in formulation of niosomes [3].

Alkyl Esters: Sorbitan esters are surfactants favored for utilization in the preparation of niosomes. Vesicles prepared by the polyoxyethylenes or bitanmonolaurate are generally soluble than other surfactant vesicles. For instance polyoxyethylene (polysorbate 60) hasbeen used for encapsulation of diclofenac sodium. A blend of polyoxyethylene-10-stearyl ether: glyceryl laurate: cholesterol (27:15:57) has been utilized as a part of transdermal delivery of cyclosporine-A.

Alkyl Amides: Alkyl amide (e.g. galactosides and glucosides) have been used to deliver niosomal vesicles [3].

Fatty Acid and Amino Acid Compounds: Long chain fatty acids and amino acid moieties have also been used in some niosomes preparation [3].

1.1.2 Cholesterol

Steroids are critical parts of the cell film and their presence influence the bilayer fluidity and penetrability. Cholesterol is a steroid derivative, which is mainly utilized for the formulation of niosomes. Despite the fact that it may not demonstrate any part in the formation of bilayer, its significance in formation of niosomes and control of layer attributes cannot be disposed of [3]. Inclusion of cholesterol influences properties of niosomes like membrane permeability, inflexibility, encapsulation efficiency, simplicity of rehydration of freeze dried niosomes and their harmfulness. It keeps the vesicle accumulation by the consideration of atoms that balance the system against the formation of aggregates by repulsive steric or electrostatic forces that prompts the change from the gel to the liquid phase in niosome systems. Thus, the niosome turns out to be less leaky in nature [3].

1.1.3 Charged Molecule

Some charged molecules are added to niosomes to increase stability of niosomes by electrostatic

repulsion to avoid coalescence. The negatively charged molecules utilized are diacetyl phosphate (DCP) and phosphotidic acid. Similarly, stearyl amine (STR) and stearyl pyridinium chloride are well known positively charged molecules utilized in niosomal preparations. A concentration of 2.5-5 mole percentage of charged molecules is tolerable because higher concentration can hinder the niosome formation [3].

1.2 Structure of Niosomes

Niosomes are microscopic lamellar structures, which are shaped on the admixture of non- ionic surfactant and cholesterol with resulting hydration in aqueous media. Structurally, niosomes are like liposomes, in that they are comprised of a bilayer. However, the bilayer in the case of niosomes is made up of non-ionic surface active agents rather than phospholipids as with liposome's. Most surface active agents when submerged in water yield a micellar structure. However some surfactants can yield bilayer vesicles which are niosomes. Niosomes might be unilamellar or multi lamellar relying upon the technique used to set them up. The hydrophilic ends of the surfactant bilayer are exposed on the outside and inside of the vesicle, while the hydrophobic chains face each other within the bilayer. Thus, the vesicle holds hydrophilic medications inside the space encased in the vesicle, while hydrophobic medications are installed inside the bilayer itself [4] (Figure 1).

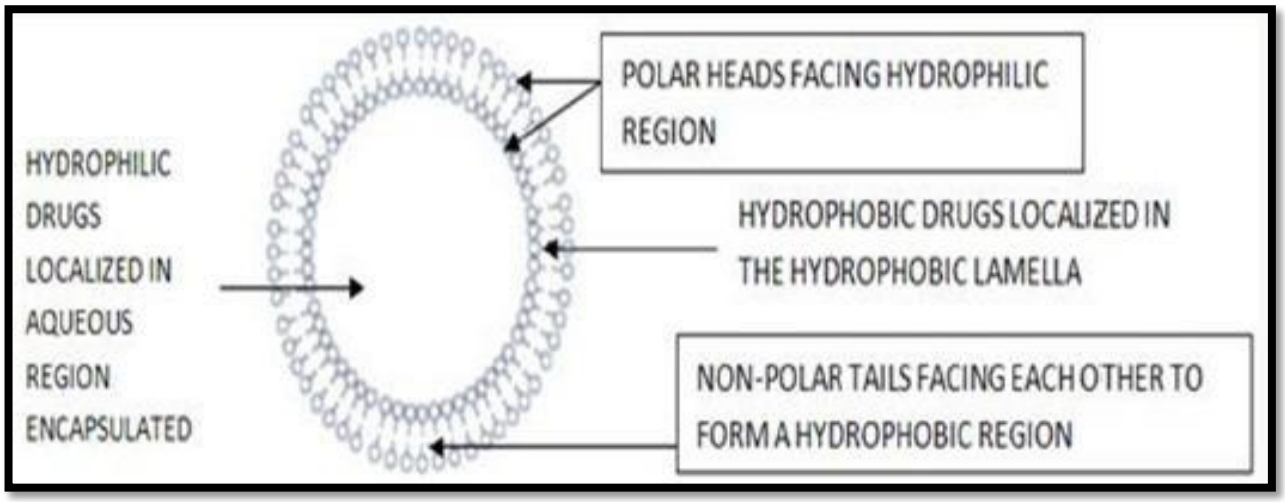


Figure 1: Structure of noisome

1.3 Types of Niosomes

Small Unilamellar Vesicles: These are usually created by sonication and French Press systems. Ultrasonic electro capillary emulsification or solvent dilution technique can beutilized to prepare SUVs. The inexact size of these vesicles is 0.025-0.05µm [5].

Multi lamellar Vesicles: It comprises of various bilayers encompassing the aqueous lipid compartment independently and display expanded trapped volume and equilibrium solute distribution, and requires hand-shaking method. They indicate varieties in lipid composition. The inexact size of these vesicles is 0.5-10µm diameter [5].

Large Unilamellar Vesicles: The infusions of lipids solubilized in an organic solvent into an aqueous buffer, can bring spontaneous development of LUV. Preparation of LUV can best be brought about reverse phase evaporation, or by detergent solubilization method. These rough vesicles reach a size of more than 0.10µm [5] (Figure 2).

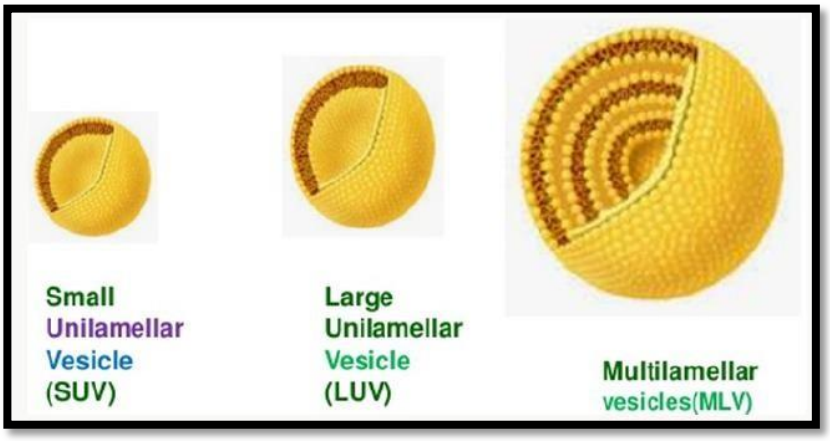


Figure 2: Types of niosomes

1.4 Methods of Preparation

A] Ether Injection Method

This technique prepares niosomes by gradually introducing a solution of surfactant dissolved in diethyl ether into warm water kept at 60°C. The surfactant mixture in ether is injected through 14-gauge needle into an aqueous solution of material. Vaporization of ether leads to formation of single layered vesicles. Utilizing such conditions, results in vesicles having a width of 50 to 1000 nm [6].

B] Hand Shaking Method (Thin Film Hydration Technique)

Hand Shaking Method (Thin Film Hydration Technique) The blend of vesicle-forming ingredients like surfactant and cholesterol are dissolved in a volatile organic solvent (diethyl ether, chloroform or methanol) in a round bottom flask. The organic solvent is expelled 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 procedure forms typical multi lamellar niosomes. Thermo sensitive niosomes were set up by Raja Naresh et al by evaporating the organic solvent at 60°C and leaving a thin film of lipid on the wall of rotary flash evaporator. The aqueous stage containing drug was included gradually with intermittent shaking of flask at room temperature took after by sonication [7,8] (Figure 3).

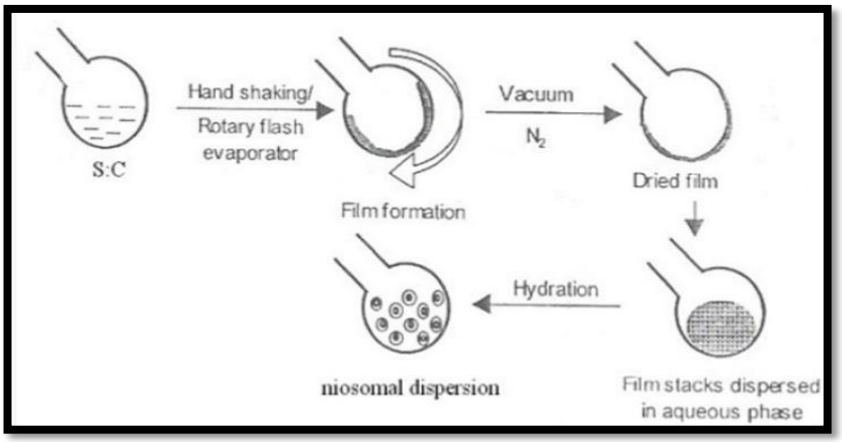


Figure 3: Hand Shaking Method

C] Sonication

It is a strategy for creation of the vesicles as described by Cable. In this technique an aliquot of drug

solution in buffer is added to the surfactant/cholesterol mixture in a 10-ml glass vial. The mixture is probe sonicated at 60°C for 3 minutes using a sonicator with a titanium probe to yield niosomes.

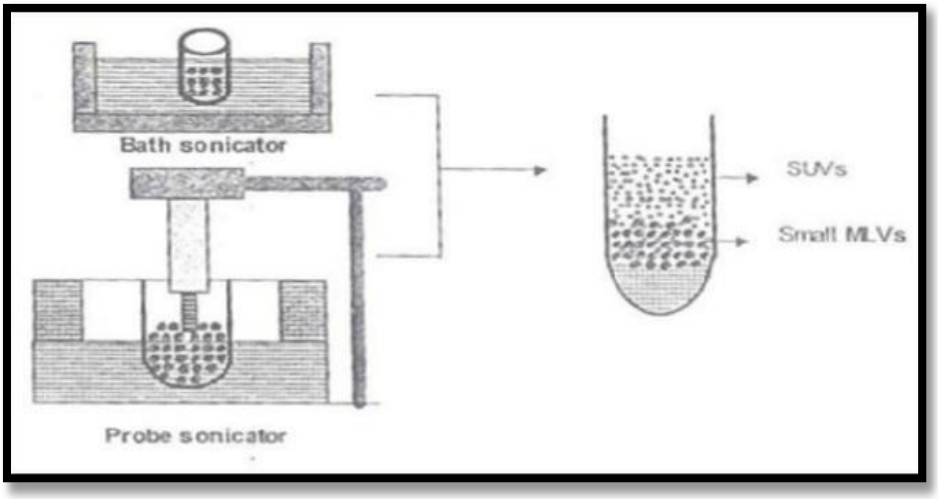


Figure 4: Sonication Method

D] Micro Fluidization

Micro fluidization is a recent procedure used to prepare unilamellar vesicles of defined size distribution. This technique depends on submerged jet principle in which two fluidizedstreams interact at ultra-high velocities, in precisely defined micro channels within the interaction chamber. The impingement of thin fluid sheet along a typical front is managed such that the energy supplied to the system remains within the area of niosome formation. The outcome is smaller size and better reproducibility of niosomes formed [9].

E] Multiple Membrane Extrusion Method

A blend of surfactant, cholesterol and diacetyl phosphate is prepared and after that solvent is evaporated utilizing rotary vacuum evaporator to leave a thin film. The film is then hydrated with aqueous drug solution and the suspension subsequently acquired is extruded through the polycarbonate layer (mean pore size 0.1mm) and then placed in series up to eight passages to get uniform size niosomes good technique for controlling niosome size. [9,10].

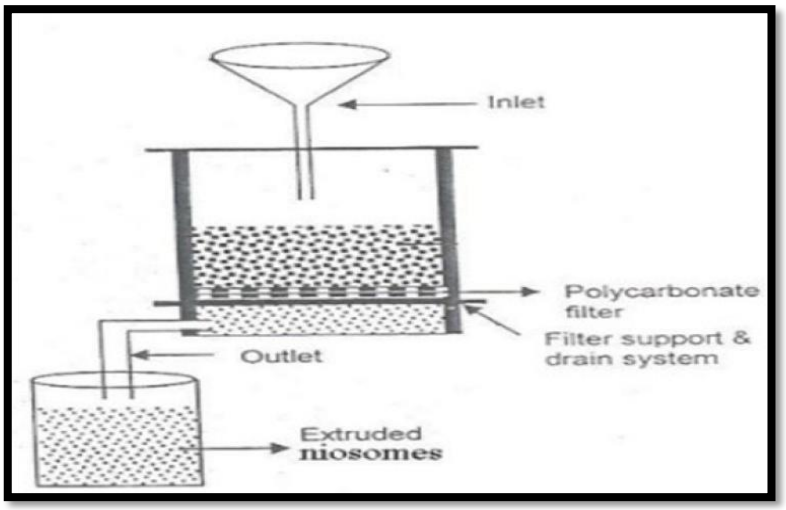


Figure 5: Multiple Membrane Extrusion Method

F] Reverse Phase Evaporation Technique (REV)

Both cholesterol and surfactant (1:1) are dissolved in a mixture of ether and chloroform. An aqueous

phase containing drug is added to this mixture and the subsequent two phases are sonicated at 4-5°C. The clear gel formed is further sonicated after the addition of a small amount of phosphate buffered saline (PBS). The organic phase is removed at 40°C under low pressure. The resulting viscous niosome suspension is diluted with PBS and warmed on a water bath at 60°C for 10 min to get niosomes [11].

G] Trans-Membrane pH Gradient (Inside Acidic) Drug Uptake Process (Remote Loading)

In this process, a solution of surfactant and cholesterol is made in chloroform. The solvent is then evaporated under decreased pressure to get a thin film on the wall of the round bottom flask, similar to the hand shaking method. This film is then hydrated utilizing citric acid solution (300mM, pH 4.0) by vortex mixing. The resulting multi lamellar vesicles are then treated to three freeze thaw cycles and sonicated. To the niosomal suspension, aqueous solution containing 10mg/ml of drug is added and vortexed. The pH of the sample is then increased to 7.0-7.2 using 1M disodium phosphate (this causes the medication which is outside the vesicle to become non-ionic and can then cross the niosomal membrane, and onceinside it is again ionized thus not allowing it to exit the vesicle). The blend is later warmed at 60°C for 10 minutes to give niosomes [12].

H] The Bubble Method

It is a procedure which has just as of late been created and which permits the preparation of niosomes without the utilization of organic solvents. The bubbling unit comprises of a round bottom flask with three necks, and this is positioned in a water bath to control the temperature. Water-cooled reflux and thermometer is positioned in the first and second neck, while the third neck is used to supply nitrogen. Cholesterol and surfactant are dispersed together in a buffer (pH 7.4) at 70°C. This dispersion is mixed for a period of 15 seconds with high shear homogenizer and immediately afterwards, it is bubbled at 70°C using the nitrogen gas to yield niosomes [13].

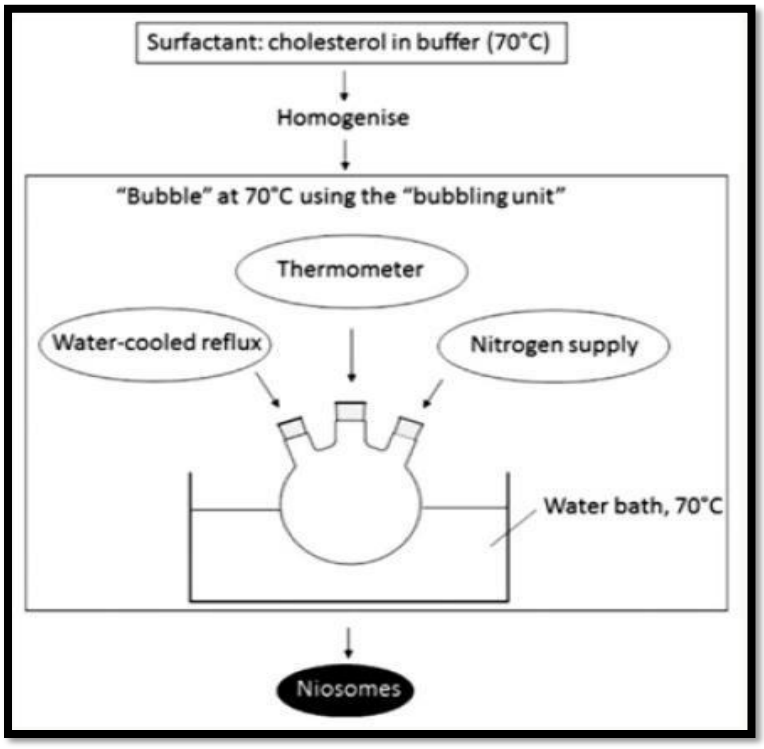


Figure 6: Bubble Method

I] Lipid Layer Hydration Method

Span 60 and cholesterol (1:1) are dissolved in chloroform and the solvent was evaporated utilizing

rotary flash evaporator. Phosphate buffer saline PH 7.4 containing drug is added to the dried thin film with gentle agitation. The blend is irregularly mixed on a vortex mixer. Sonic dispersion of the blend is completed at 25°C utilizing probe sonicator set at 200 watts for 1 minute [14].

1.5 Separation of Unentrapped Drug From Niosomes

The removal of unentrapped solute from the vesicles can be accomplished by varioustechniques, which include:

Dialysis:

The aqueous niosomal dispersion is dialyzed in dialysis tubing against phosphate buffer ornormal saline or glucose solution [16].

Gel Filtration:

The unentrapped drug is removed by gel filtration of niosomal dispersion through aSephadex-G-50 column and elution with phosphate buffered saline or normal saline [16].

Centrifugation:

The niosomal suspension is centrifuged and the supernatant is separated. The pellet is washedand then sresuspended to obtain a niosomal suspension free from unentrapped drug [16].

1.6 Characterization of Niosomes

1.6.1 Size:

Shape of niosomal vesicles is assumed to be spherical, and their mean diameter can be determined by using laser light scattering method. Also, diameter of these vesicles can be determined by using electron microscopy, molecular sieve chromatography,ultracentrifugation, photon correlation microscopy, optical microscopy and freeze fracture electron microscopy.

1.6.2 Bilayer Formation:

Assembly of non-ionic surfactants to form a bilayer vesicle is portrayed by X-cross formationunder light polarization microscopy.

1.6.3 Number of Lamellae:

This is determined by utilizing nuclear magnetic resonance (NMR) spectroscopy, small angle X-ray scattering and electron microscopy.

1.6.4 Membrane Rigidity:

Membrane rigidity can be estimated by means of mobility of fluorescence probe as a function of temperature.

1.6.5 Entrapment Efficiency:

The unentrapped medication is separated by dialysis, centrifugation, or gel filtration asdescribed above and the medication which remained entrapped in niosomes is determined by complete vesicle disruption utilizing 50% n-propanol or 0.1% Triton X-100 and analyzing theresultant solution by appropriate assay technique for the medication.

Entrapment efficiency = (Amount entrapped / total amount) x 100

1.6.6 pH Measurement:

The pH of niosomes can be measured by a pH meter. The pH estimation is performed at25°C.

1.6.7 Zeta Potential Measurement:

Zeta potential of suitably diluted niosome dispersion is carried out using zeta potential analyzer

which is based on electrophoretic light scattering and laser Doppler velocimetry method. The temperature is set at 25°C. The charge on vesicles and their mean zeta potential values can hence be determined directly.

1.7 Advantages of Niosomes

A. Niosomes are less costly compared to liposomes. They have higher chemical stability dueto absence of phospholipids which are inclined to oxidative degradation.
B. Niosomes prolong the circulation of entrapped drug. They can be relied upon to target thedrug to its wanted site of action and to control its discharge.
C. The use of niosomes in cosmetics preparation has the following advantages:
    1. The vesicle suspension being water based offers more patient compliance over oil based systems.
    2. Since the structure of the niosome offers place to suit hydrophilic, lipophilic and in addition ampiphilic drug moieties, they can be utilized for an assortment of drugs.
    3. Niosome characteristics such as size, lamellarity etc. of the vesicle can be fluctuated relying upon the requirement
    4. The vesicles can act as a depot to release the medication gradually and offer a controlled release.
D. They are osmotically active and stable.
E. They increase the stability of the entrapped drug
F. Handling and storage of surfactants do not require any special conditions
G. Can increase the oral bioavailability of drugs
H. Can enhance the skin penetration of drugs
I. They can be utilized for oral, parenteral and topical use
J. The surfactants are biodegradable, biocompatible, and nonimmunogenic
K. Improve the therapeutic action of the drug by shielding it from the biological environment and restrictions to target cells, in this manner diminishing the clearance of the drug.

1.8 Disadvantages of niosomes

1. It may decrease their shelf life
2. It include physical and chemical instability, aggregation, fusion of vesicles
3. Leaking or hydrolysis of the encapsulated drug
4. Moreover, the methods required for preparation of multilamellar vesicles, such as extrusion or sonication, are time-consuming and may require specialized equipment for processing.

1.9 Applications of niosomes

Niosomes were introduced for use in the cosmetic industry. The first report on surfactant vesicles came from the cosmetic applications devised by L'Oreal. Phospholipids and nonionic surfactant have been reported to act as penetration enhancers that can overcome the barrier of transdermal drug delivery. Since then, there has been increasing interest in the use of niosomes in the pharmaceutical, cosmetic, and food industries, leading to the publicationof more than 1,200 research articles, about 200 patents, and six clinical trials from 1980 onwards. Most of these publications make reference to the importance of characterization of nanovectors.

Niosomal carriers are suitable for the delivery of numerous pharmacological and diagnostic agents, including antioxidants, anticancer, anti-inflammatory, antiasthma, antimicrobial, anti- Alzheimer's, and antibacterial molecules, oligonucleotides, and others. Depending on the type of drug, surfactant, disease, and anatomical site involved, various routes of administration exist for niosomal drugs, ie, intravenous, intramuscular, oral, ocular, subcutaneous, pulmonary, and transdermal. Several other routes have been used to administerniosomal drugs, including the intraperitoneal and vaginal routes. Niosomes have been used for successful targeting of drugs to various organs like the liver and brain or to pathological districts such as tumor, enhancing drugs pharmacological activities while reducing side effects. In particular, targeted niosomal systems have been designed with different mechanisms of action, including active, passive, and magnetic targeting, leading to more advanced and specific macromolecular drug carriers.

1.10 Toxicity of niosomes

The toxicity of niosomes is related to their components, ie, nonionic surfactants are more biocompatible and less toxic than their anionic, amphoteric, and cationic counterparts. When the same surfactants are in the form of vesicular systems, these properties strongly decrease. There is little research published on the toxicity of niosomes and the types of surfactant included. Hofland et al evaluated the toxicity of the types of surfactant used in niosomal formulations to human keratinocytes, and demonstrated that ester types of surfactant are less toxic than ether types due to enzymatic degradation of bonds in esters. Hemolytic tests are traditionally used to predict the toxicity of a surfactant and in vesicular systems derived from them. Recently, it has been demonstrated that the ability of niosomes to disrupt erythrocytes depends on the length of the alkyl chain in the surfactant and on the size of the colloidal aggregates in solution. Presumably, a shorter carbon chain intercalates better into the membranes of erythrocytes, destructing their molecular organization; niosomes have more difficulty to interact with biological membranes, resulting in substantial hemolysis. Niosomes prepared with bolaform surfactants showed encouraging safety and tolerability data both in vitro in human keratinocytes and in vivo in human volunteers, who showed no skin erythema when topically treated with a drug-free bolaform niosome formulation.

1.11 Mechanisms of action of niosomes as permeation enhancers

There is no single mechanism that can sufficiently explain the ability of niosomes to increase drug transfer through the skin, and several mechanisms have been proposed, including: alteration of the barrier function of the stratum corneum, as a result of reversible perturbation of lipid organization; reduction of transepidermal water loss, which increases hydration of thestratum corneum and loosens its closely-packed cellular structure; and adsorption and/or fusion of niosomes on the surface of the skin, as revealed by freeze fracture electron microscopy and small angle X-ray scattering, leading to a high thermodynamic activity gradient of drug at the interface, which is the driving force for permeation of a drug.

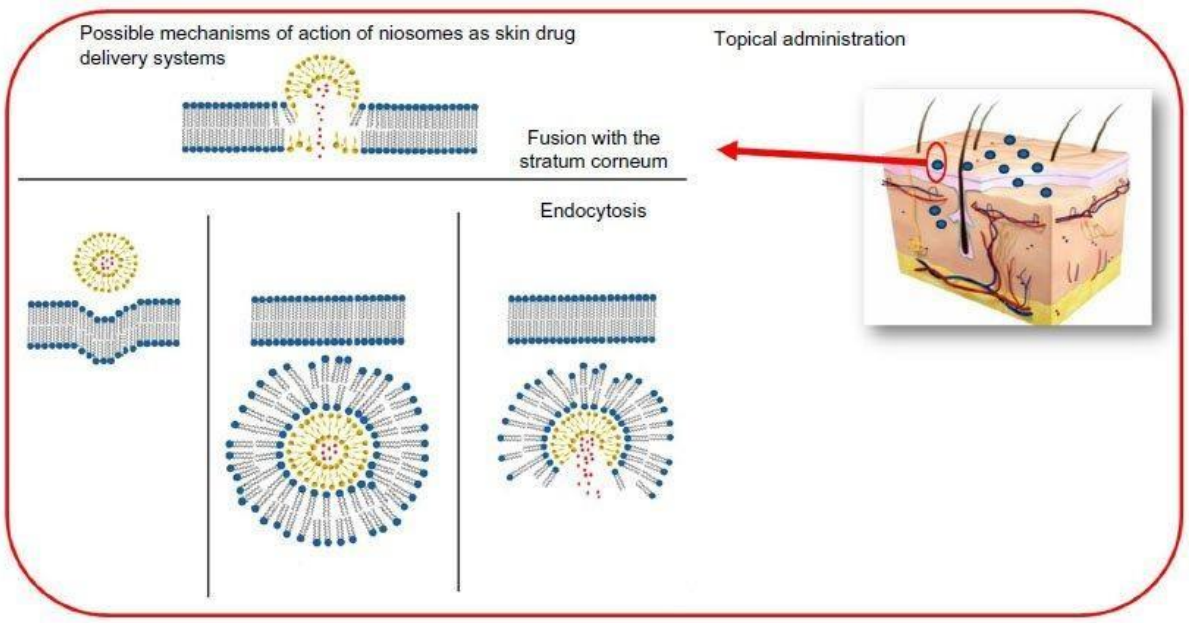


Figure 7: Mechanisms of action of niosomes as skin drug delivery systems

Adsorption of niosomes onto the cell surface occurs with little or no internalization of either aqueous or lipid components; it may take place either as a result of attracting physical forces or as a result of binding by specific receptors to ligands on the vesicle membrane and transfer of drug directly from vesicles to the skin. On the other hand, niosomes may fuse with the cell membrane, resulting in complete mixing of the niosomal contents with the cytoplasm. Finally, niosomes may be engulfed by the cell (endocytosis), with lysozymes present in the cytoplasm degrading or digesting the membranous structure of the niosome, thereby releasingthe entrapped material into the medium.

2. MATERIAL & METHODS

All chemicals of laboratory grade were purchased from Loba Chemie Pvt Ltd. Non ionic surfactant eg. SLS and Tween 80 was also purchased of laboratory grade.

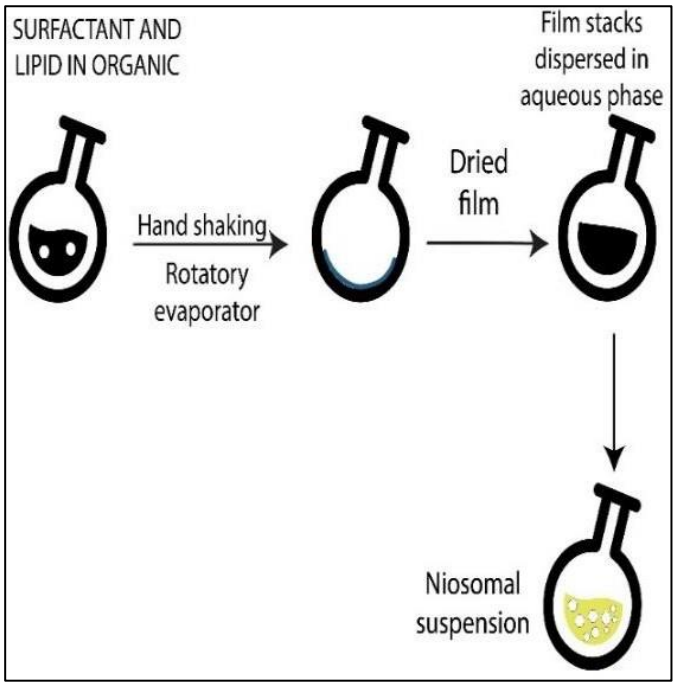
Method

Preparation of niosomes

Briefly, 100 mg of tween 80, 20 mg of stearic acid and 10 mg of drug were dissolved in 20 ml of chloroform. The solution was kept for intermittent stirring with a magnetic stirrer for 1 h. After 1 h, the resultant solution was shaken by hand for evaporation, which results in formation of a thin film. In order to get a completely dried film the flask was kept in a vacuum desiccator for 1 h.

3. EXPERIMENTAL

Niosomes are prepared by dissolving both cholesterol and surfactant (1:1) in a mixture of ether and chloroform. An aqueous phase containing drug is added to this mixture and the subsequent two phases are sonicated at 4-5°C. The clear gel formed is further sonicated after the addition of a small amountof phosphate buffered saline (PBS). The organic phase is removed at 40°C under low pressure. The resulting viscous 10oisome suspension is diluted with PBS and warmed on a water bath at 60°C for 10 min to get niosomes. Here hand shaking method was used.



4. RESULT & DISCUSSION

Niosomes were formulated by hand shaking method using non ionic surfactant (eg. SLS,Tween 80) and linking agent stearic acid.

Formulated niosomes was further characterized using digital microscope.

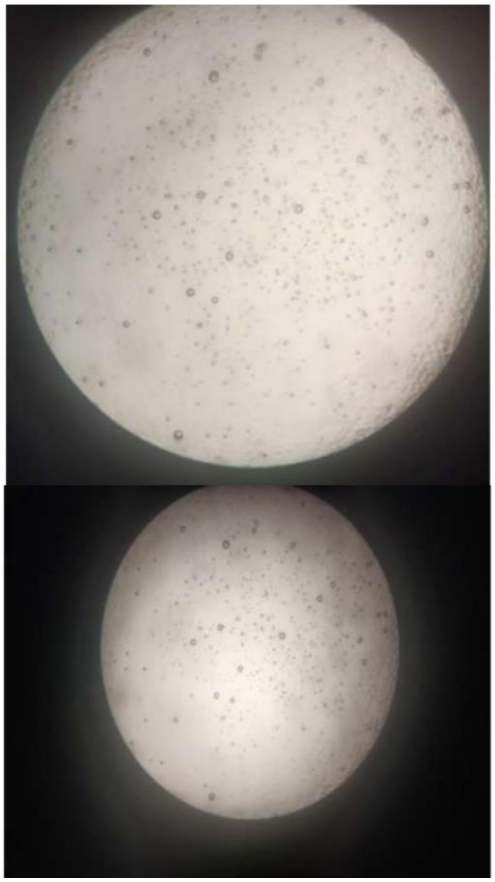


Figure 8: Microscopic images of niosomal formulation

Particle size analysis

Measurement Results

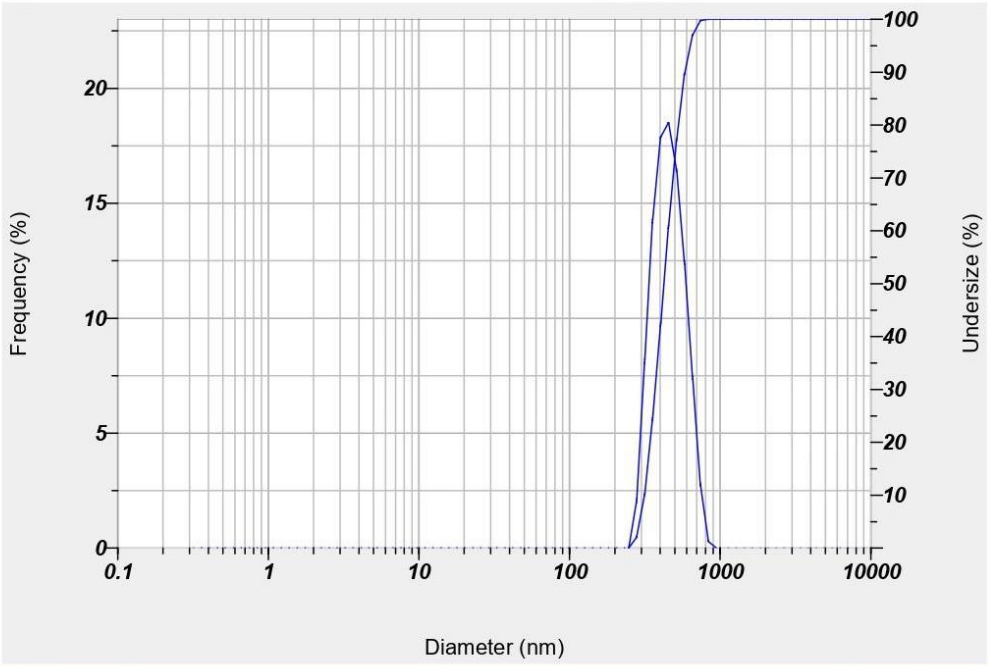
Date	: Monday, May 23, 2022
Measurement Type	: Particle Size
Sample Name	: 1:1
Scattering Angle	: 90
Temperature of the Holder	: 25.0 °C
Dispersion Medium Viscosity	: 0.896 mPa·s
Transmission Intensity before Meas.	: 11003
Distribution Form	: Standard
Distribution Form(Dispersity)	: Monodisperse
Representation of Result	: Scattering Light Intensity
Count Rate	: 433 kCPS

Calculation Results

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	438.1 nm	103.6 nm	425.8 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	1.00	438.1 nm	103.6 nm	425.8 nm

Cumulant Operations

Z-Average	: 984.6 nm
PI	: 0.552



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Particle size of formulated niosomes was found below 1000 nm.

Entrapment efficiency

Process variables like a vacuum, hydration medium, hydration time and speed of rotation of the flask are important to prepare niosomes. Improper selection of these parameters may result in improper hydration resulting in formation of fragile niosomes or drug leakage from niosomes. The rotational speed of the flask demonstrated discernible influence on the thickness and uniformity of the lipid film. The hydrating temperatures used must be above the gel liquid phase transition temperature of the system. The results reflect the effect of phase transition temperatures in terms of increased entrapment

efficiency. Addition of CHO to the surfactant was required to form stable nonionic surfactant based vesicles. CHO almost always present in lipid vesicles as well as bio-membranes and influences a number of membrane properties such as ion permeability, aggregation, fusion process, elasticity, size and shape. Being amphipathic, CHO can insert itself into the bilayer membrane with its hydrophilic head oriented towards the aqueous surface and aliphatic chain line up parallel to the hydrocarbon chains in the center of the bilayer. It is known that CHO increases the chain order of the liquid-state bilayer and strengthen the non-polar tail of the non-ionic surfactant. An increase in CHO concentration, lead to an increase in the entrapment levels of Ketoconazole. The increase in the entrapment efficiency is attributed to the ability of CHO to cement the leaking space in the bilayer membranes, which in turn allow enhanced drug level in niosomes. Entrapment efficiency increases with an increase in surfactant concentration and more time is taken for maximum drug release. The entrapment efficiency was determined by separating the unentrapped drug using dialysis.

%EE=(dt−df/dt)×100

Here, d_t = total amount of drug; d_f = amount of free drug

%EE= 100 – 18.7/ 100 x 100

% EE= 81.3%

Drug loading capacity (%DL)

It can be calculated as per formula.

%DL=Amount of total entrapped drug/Total weight of nanoparticles∗100

%DL= 81.3/100 x 100

Scanning electron microscopy

The surface morphology of the formulation was studied by using SEM. The prepared niosomal formulation was deep frozen and lyophilized prior to SEM. A double-sided conducting tape was taken, and the lyophilized sample was spread over it. Then, the coating was done with gold by using gold sputter under vacuum condition but in the presence ofargon gas at 50 mA for 100 s**.**

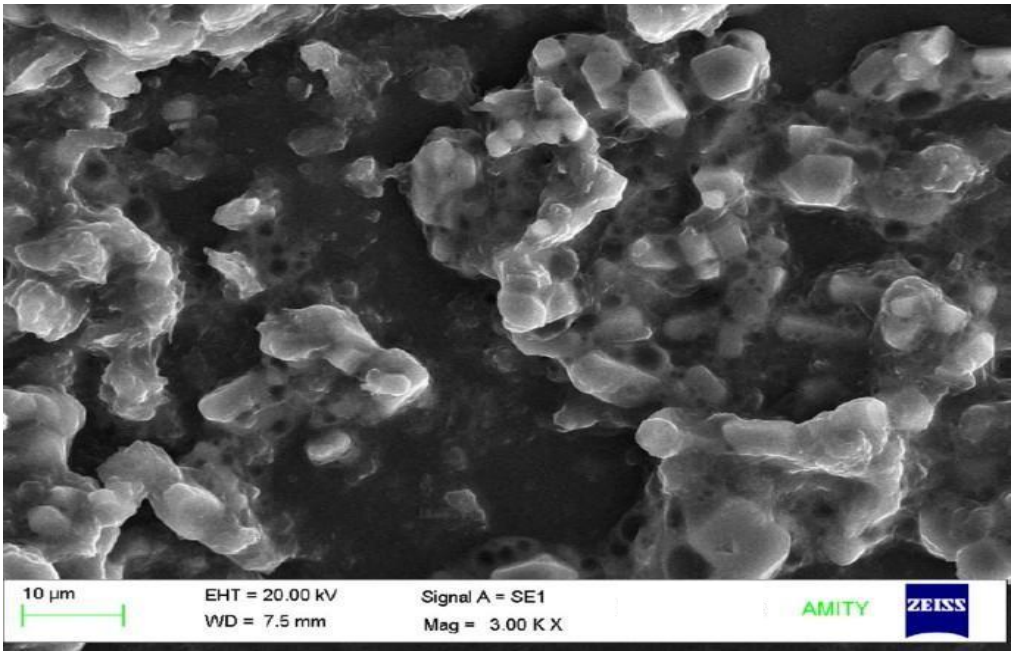

Figure 9: SEM Photomicrograph of formulation

5. CONCLUSION

Niosomes drug delivery system is an effective approach towards novel drug delivery. Niosomes are composed mainly of non-ionic surfactants and cholesterol. Niosomes might be set up by different techniques like ether injection method, hand shaking method, sonication method, reverse phase evaporation method, remote loading method, extrusion method and micro fluidization method. The properties of niosomes are influenced by additives, methods of preparation, drug properties, amount, structure and type of surfactant utilized, cholesterol and resistance to osmotic pressure. Briefly, as a drug delivery device, compared to liposome's, niosomes are osmotically active and are quite stable chemically by their own as well as enhance the stability of the medication so entrapped and delivered. They don't require special conditions for handling, protection or storage and industrial manufacturing. Adjacent to this, they offer flexibility in structural characteristics (composition, fluidity, size), and can be composed as desired. Niosomes offer different favorable circumstances over other drug delivery devices and have found applicability in pharmaceutical field. It was thus concluded that niosomes are very effective drug delivery tools for incorporation/targeting of various therapeutically active moieties and the onus lies on future scientists to effectively harness its potential in diverse application areas for the benefit of humanity.

Niosomes have been demonstrated to be promising controlled delivery systems for percutaneous administration of both hydrophilic and lipophilic drugs. The potential of niosomes can be enhanced by using novel preparation, loading, and modification methods. These areas need further exploration and research for the development of niosomal preparations that can be made commercially available. Researchers should be alert in theneed for appropriate selection of suitable surfactants for preparation of niosomes, given that the type of surfactant used is the main parameter determining the successful formation of these vesicles, along with their toxicity, stability, and potential applications.

6. REFERENCES

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