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RESEARCH ARTICLE OPEN ACCESS

Niosomes Drug Delivery System Review Article

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Abstract:

Niosomes are vesicles made from non-ionic surfactants. They are created by hydrating a mixture of cholesterol and non-ionic surfactants. Niosomes are non-ionic surfactant vesicles made by hydrating cholesterol Linta V., Daisy P.A., and Boby Johns G. discuss noisome drug delivery systems, focusing on how they are formulated and their various applications. Niosomes are a type of vesicle that can improve the delivery of drugs in the body, making treatments more effective. The article from 2017 explores different techniques for creating Niosomes and highlights their potential benefits in medical treatments, such as enhanced drug stability and targeted delivery. The study emphasizes the promising role of Niosomes in improving the effectiveness of drug therapies.tant mixtures. They serve as carriers for amphiphilic and lipophilic drugs in this delivery system. Medications are encapsulated in vesicles.Niosomes are biodegradable, biocompatible, non-immunogenic, and have flexibThe review aims to highlight the various applications of niosomes in treating multiple diseases.structures.

This article reviews various aspects of Niosomes, including their preparation methods and how they work. Niosomes are non-ionic surfactant-based vesicles mainly used in drug delivery. The text explores Niosomes' benefits, such as being stable and helping drugs stay in the body longer. Comparisons with liposomes show Niosomes are less costly and have easier storage. Different preparation methods like sonication and extrusion are discussed. The article also covers how Niosomes release drugs at the target site through different delivery routes. Overall, Niosomes are useful in medicine new developments.

Niosomes are useful in helping drugs pass through barriers in the body, acting as permeation enhancers. They encapsulate drugs, improving their delivery and effectiveness. Niosomes can be used to treat various diseases by delivering drugs directly to the affected areas, enhancing the treatment's impact while potentially reducing side effects. However, niosomes can sometimes be toxic. This toxicity can be managed and reduced by using surfactants, which help stabilize niosomes and minimize any harmful effects.

Keywords : Niosomes are spherical vesicles used to encapsulate drugs or other substances for delivery. They are made using surfactants, which are compounds that reduce surface tension and enable the formation of these vesicles. There are several methods to prepare Niosomes, each varying based on the intended application and desired characteristics of the vesicles. Niosomes can be used in various applications, including drug delivery, cosmetics, and health supplements, due to their ability to improve stability and absorption. It's important to consider the potential toxicity of the surfactants and other materials used in making Niosomes to ensure they are safe for use.

INTRODUCTION

In 1909, researcher Paul Ehrlich began developing targeted drug delivery aimed at directing drugs specifically to infective cells.

In 1909, Paul Ehrlich began exploring targeted delivery by developing a drug delivery method aiming directly at infective cells. Drug targeting refers to directing a therapeutic agent to a specific site to act effectively on targeted tissue.

The text describes a medication delivery system where the medication is enclosed in a polymer matrix forming vesicles. These vesicles have a double layer made of non-ionic surfactant, which is important for their structure and function.
Niosomes are vesicles that are amphiphilic, meaning they have both water-loving and fat-loving properties. These structures do not contain surfactants, which are substances that reduce surface tension.
Span-60 is typically stabilized by adding cholesterol and a significant amount of anionic surfactant, like dicetyl phosphate.

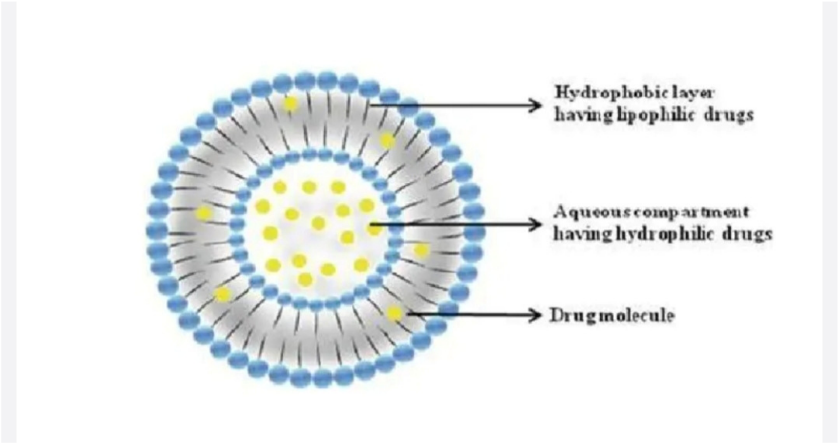
Merits of Niosomes
A smaller dose can still provide the desired effect.
Niosomes are stable because they use a hydrophilic system. Their hydrophilic nature makes them osmotic ally active.
The drug Is hydrophilic, meaning it attracts water, which helps increase its stability. Additionally, it can improve the penetration of drugs into the skin.
The vesicles in the suspension are hydrophilic, leading to high patient acceptance compared to oil-based systems.
Vesicles store drugs and release them slowly over time.

DEMIRITS OF Niosomes
The text highlights three main points. First, it may need specialized equipment. Second, it has high production costs. Third, it is inefficient at drug loading.
The text discusses issues related to drug delivery systems. It highlights problems such as fusion, aggregation, and the leakage of drugs from their encapsulating structures. Additionally, it notes that hydrolysis can negatively impact the stability of these encapsulated drugs, which in turn limits their shelf life.

STRUCTURE OF NIOSOMES
Niosomes are vesicles that are made using non-ionic surfactants like Span-60. They are stabilized when cholesterol is added.
Anionic surfactants like dicetyl phosphate are used to stabilize niosome vesicles.

Composition of niosomes
Niosomes are created using several components which work together for their formulation. These components include surfactants, cholesterol, and sometimes additional stabilizing agents. Surfactants help to form the structure of the niosomes, while cholesterol provides stability and rigidity to the vesicles. Optional stabilizers may further enhance the niosomes' ability to hold and deliver substances effectively.
1**cholesterol**
2non ionic surfactant agent
Cholesterol
The text describes steroids' derivatives that are used to make things flexible, firm, and correctly shaped.

2 non ionic surface acting agent



The text lists examples of non-ionic surfactants used in making Niosomes, such as Span varieties (Span 20, 40, 60, 80, 85) and Tween varieties (Tween 20, 40, 60, 80).
Brijs are non-ionic surfactants that have a hydrophilic head and a hydrophobic tail.

PRPARATION OF NIOSOMES

Sonication method

Niosomes are organized using various systems to manage drug solutions. The arrangement depends on the type of system used.
Buffer system and drug are mixed with a surfactant or similar substance.
The text describes a glass vial containing a 20ml mixture of cholesterol.
The mixture is sonicated using a sonicator with a titanium probe at 60°C for 3 minutes to produce niosomes.

Hand shaking method (thin flim hydration Technique) :4

Surfactant and cholesterol can be dissolved in a volatile organic solvent, such as diethyl ether.
In a round bottom flask, chloroform and methanol are mixed. The mixture is then treated at room temperature (20°C) using a rotary evaporator. This process removes the organic solvent, leaving behind a thin layer of solid residue on the flask's walls.
A surfactant used In making a film can be rehydrated with water at temperatures between 0-60°C and gentle agitation to produce multilamellar niosomes.

Micro fluidization method (4)

This text mentions new technology used to create unilamellar vesicles with a specific size range.
Micro fluidization involves two fluid streams moving at extremely high speeds and interacting with one another.
Microfluidization relies on two streams of fluid moving at very high speeds that collide with one another.
A thin liquid sheet impacts a surface in a way that supports noisome formation, provided the energy given to the system is appropriate.
The results show that niosomes may become more uniform, smaller in size, and easier to reproduce.

REVERSE PHASE EVAPORATION TECHNIQUE (REV) (7)

Chloroform and ether are organic materials. A drug is dissolved in the aqueous phase and added to a mixture with these materials. This creates two phases, which are then sonicated at a temperature of 4-5°C.
After adding phosphate buffered saline, an organic phase is present. This phase is removed at 40°C, and the pressure is low.
The niosomes solution is originally thick and needs to be thinned using a phosphate buffer.

The solution is heated in a water bath at 60°C for 10 minutes, which is optimal for achieving the highest yield of niosomes.

THE BUBBLE METHOD (8)

The foaming unit consists of a round-lined flask with three necks. It will be placed in a water bath to control the temperature

A thermometer and water-cooled reflux are in the primary and second necks, while the third neck provides nitrogen.

Cholesterol and surfactant are combined in a buffer with a pH of 7.4. This mixture is heated to 70°C and then mixed together.

A high shear homogenizer is used for 15 seconds, and then nitrogen gas is bubbled through the mixture at 70°C to produce niosomes.

FACTOR AFFECTING NIOSOMES FORMULATION (13)

1 drug
2 Nature of type of surfactant
3 Cholesterol content and charge
4 Resistance to osmotic. Stress
5 Temperature of hydration

1.Drugs

When drugs are entrapped in niosomes, they affect the charge and rigidity of the niosome bilayers.

The balance between water-attracting and fat-attracting properties of drugs affects how well they are contained or trapped.

The hydrophilic and lipophilic balance of the drugs affects how well they are trapped or held within a system.

2.Nature and type of Surfactant (9)

The text discusses that the size of niosomes increases as the Hydrophilic-Lipophilic Balance (HLB) of the surfactant increases. This implies a direct relationship between noisome size and surfactant HLB values.

When the HLB (Hydrophilic-Lipophilic Balance) of a surfactant like Span 85 increases, the will increases proportionally. This happens because as the surfactant becomes more hydrophobic, the surface free energy decreases.

A surfactant must have a water-loving (hydrophilic) head and a water-repelling (hydrophobic) tail. The hydrophobic part is essential for the surfactant's function.

The text describes a chemical structure that can include one or two alkyl groups, perfluoroalkyl groups, or sometimes just a single steroidal group.

3.Cholestrol content and charge (10, 21)

Cholesterol helps increase both the entrapment efficiency and the hydrodynamic diameter of niosomes.

It helps to stabilize membranes and reduces their leakiness.

If cholesterol content in a bilayer increases, the release rate of encapsulated material may decrease, leading to increased rigidity of the bilayers.

The presence of charge in multilamellar vesicle structures makes the layers in between bilayers wider and increases the total volume that can be contained.

4.Resistance Osmotic Stress
Adding a hypertonic salt solution to niosomes suspension reduces their diameter.

5.temperature of hydration
The shape and size of niosomes depend on the temperature at which they are hydrated.

CHARACTERIZATION OF NIOSOMES
1.Measurement of angle of Repose
The angle of repose for dry powder niosomes can be determined using the funnel method.
The powder of niosomes is placed into a funnel positioned so that its 13mm outlet is 5cm above a level black surface.
The powder flows down and forms a small mountain-like shape.
The angle of repose was calculated by measuring the height and diameter of the mountain's base.

2.Scanining electron microscopy (14)
Particle size is a crucial characteristic of niosomes.
The text discusses the surface characteristics and size distribution of niosomes. It focuses on aspects such as how round and smooth they are, how they form into aggregates, and the range of their sizes.
The text describes the process of examining niosomes using scanning electron microscopy (SEM). It involves sprinkling the niosomes onto double-sided tape that is attached to aluminium stubs.
The aluminum stub was put in the vacuum chamber of the scanning electron microscope.
The sample was examined for its shape and structure using a gaseous secondary electron detector.

3.Osmotic shock (14)
The size of vesicles can be determined by conducting osmotic studies.
The text discusses placing vesicles in a hypertonic solution for three hours. After this time, changes in the vesicle size are observed.
Optical microscopy is used to examine the formulation.

4.Stability studies
To determine the stability of niosomes, it is necessary to evaluate several factors. These factors include the size, shape, and surface charge of the niosomes, as well as their encapsulation efficiency. The temperature and pH conditions during storage also play a crucial role in their stability. Monitoring these elements helps in assessing how well the niosomes can maintain their structure and function over time.
The optimized batch was kept in sealed vials at varying temperatures to assess surface characteristics and drug percentages.
Niosomes and niosomes made from proniosomes were evaluated for stability based on how well they retained certain elements.
If a formulation is unstable, it may lead to drug leakage.

5. Zeta potential analysis (6)
We need to perform a zeta potential analysis to understand the colloidal properties of the formulation we have created.
The diluted niosomes, derived from proniosomes dispersion, were assessed for their charge using a zeta potential analyzer. This analysis was conducted using electrophoretic light scattering and laser doppler velocimetry method.

The text discusses the measurement of the charge on vesicles, specifically focusing on their mean zeta potential values. These measurements, including their standard deviations, were directly obtained. The temperature for the process was set at 25°C.

In -vitro method of niosomes (18)
In vitro drug release can be studied by following ways
. Dialysis tubing
. Reverse dialysis
. Franz diffusion cell

1.Dialysis tubing
In-vitro drug release can be done using dialysis tubing.
A niosomes is placed inside a prewashed dialysis tube, which can be tightly closed to form a seal.
A dialysis sac is placed in a suitable dissolution medium at room temperature. Over time, samples can be taken from the medium.
The maintenance of sink condition is essential.

2.Reverse Dialysis
The technique involves placing a small dialysis bag containing 1ml of dissolution medium inside proniosomes.
The main point of the text is about introducing a method related to proniosomes, which involves two processes: displacing the substance into a dissolution medium and directly diluting the proniosomes.
The text discusses a method that can help, but it notes that the rapid release involved in the process cannot be measured or quantified accurately using this method.

3.Franz Diffusion Cell
This text explains a method for conducting an in-vitro diffusion study using a Franz diffusion cell. To perform this study, proniosomes are placed in the donor chamber of the Franz diffusion cell, which is equipped with a cellophane membrane.
Proniosomes can be dialyzed at room temperature using suitable dissolution media.
At regular intervals, a sample is taken and analyzed to check the drug content using a suitable method.
Maintaining the sunk condition is crucial for UV spectroscopy, HPLC, and other similar techniques.

Application of Niosomes(10.21)
The text discusses the use of a method or tool to study the immune system's reaction when exposed to an antigen.
The text mentions that it is widely used to study drug targeting.
It can be used as a treatment against cancer.
Niosomes are being studied as possible carriers for hemoglobin.
Peptide drugs can now be delivered more effectively.
The text indicates that it can provide a beneficial therapeutic effect in delivering drugs for eye treatments.
The text likely describes something that is commonly used as a tool for diagnosing conditions or issues, enabling identification of specific problems.

Immunological application of niosomes (22)
Niosomes can be utilized to study how the immune system responds when stimulated by antigens.
Niosomes are useful for delivering drugs to organs beyond the Reticulum-endothelial system.
Carrier systems are used with niosomes to target specific organs in the body.

Sustained Release (22)

The text discusses the concept of sustained release and how it can be applied to drugs. Sustained release involves controlling the release of a drug into the body over a period of time, leading to a gradual effect rather than an immediate one. This approach can improve the effectiveness of certain medications by providing a consistent therapeutic level, minimizing side effects, and reducing the need for frequent dosing.

The text discusses substances that have a low therapeutic index, meaning their effective and toxic doses are very close, making them risky to use. Additionally, these substances also have low solubility, which can affect how they are absorbed and utilized in the body.

Localized drug Action (22)

Niosomes are a modern method used in drug delivery to achieve targeted drug effects due to their small size. They help in delivering drugs to specific areas of the body, improving the efficiency and effectiveness of treatments.

The text explains that low penetrability through the epithelium and connective tissue helps to keep the drug localized at the administration site.

Transdermal delivery of drugs by niosomes (22)

Transdermal drug delivery faces a significant challenge due to the slow penetration of drugs through the skin. This limited absorption is a primary drawback, affecting the efficiency of delivering medication through this method.

Transdermal drug delivery can be accomplished using niosomes.

Topical niosomes can act as a solubilization matrix and serve as a local depot.

The text discusses the use of enhancers to improve skin absorption for long-lasting effects of active compounds.

Ieishmaniasis (22)

Leishmaniasis is a disease where a parasite from the genus Leis mania infects liver and spleen cells.

Niosomes are used to deliver drugs into the body effectively while minimizing side effects

ROUTE OF APPLICATION OF NIOSOMES DRUGS (1)

Intravenous route

Doxorubicin, camptothecin, insulin, and zidovudine are all examples of different drugs.

Inhalation

Examples: All trans-retonic acids

Transdermal route

Examples: piroxicam, estradiol, nimesulide

Ocular route

Examples: timolol maleate, cyclopentol

Nasal route

Examples: sumatriptan ,influenzaviral vaccine

Toxicity of niosomes

Niosomes are less toxic compared to other types because they contain non-ionic surfactants, which are more biocompatible.

When surfactants are organized in a vesicular form, it enhances their efficiency and functionality. These vesicles can improve the delivery and effectiveness of active ingredients in various applications.

Niosomes' properties significantly decrease upon certain conditions. Hofland and colleagues evaluated the toxicity of various surfactants used in niosomes formulations on human skin cells called keratinocytes. The text discusses types of surfactants used in niosomes formulations and their effect on human keratinocytes. It highlights ester-type surfactants as being less toxic because they can be broken down by enzymes
A hemolytic test is used to predict the toxicity of a surfactant and in vesicular systems that originate from them.
The ability of niosomes to disrupt red blood cells depends on the length of the alkyl chain in the surfactant
A shorter carbon chain can fit more easily into the layers of erythrocytes, disrupting their molecular organization.
Niosomes have difficulty interacting with natural membranes, leading to considerable hemolysis.
Niosomes made with bolaform surfactants have shown promising results in terms of safety and tolerance in laboratory studies.
The text discusses an observation involving human keratinocytes and human volunteers. The volunteers did not experience skin erythema after being treated topically with a medication-free bolaform noisome.
In studies with human volunteers, applying a medication-free bolaform niosome on the skin did not cause any redness or irritation.

Niosomes As percutaneous Enhancers'

When using niosomes on the skin, decide if a local impact within the skin (dermal drug delivery) or a systemic effect with absorption through the skin (transdermal drug delivery) is needed.
Transdermal targeting involves delivering medication through the skin to reach the circulatory system. This method is gaining significant attention from many drug resistance
The text discusses the focus on illnesses such as inflammation, cancer, psoriasis, alopecia, and acne. It highlights that the transdermal route of drug administration offers several advantages over traditional methods.The transdermal method of delivering medication has several advantages over traditional methods
The text discusses avoiding certain issues associated with intravenous treatment, such as high and low serum levels, by considering the first-pass metabolism in the liver and degradation in the gastrointestinal system, including factors like pH, enzyme activity, and interactions with food.
Medications taken by mouth, along with foods and drinks, can sometimes interfere with each other. This interference can affect how well the medication works and how much of it the body absorbs. Using a different way to take medication, rather than by mouth, can sometimes help increase its effectiveness and absorption.Transdermal medication is preferred when other methods cause issues like vomiting and diarrhea. Benefits include easy skin application, large absorption area, and a painless process, enhancing patient comfort.
The text explains that using a transdermal method to deliver medication has a major downside: it does not penetrate the skin very well.
Only certain medications can be made into transdermal delivery systems because the outer skin layer, called the stratum corneum, slows down the rate at which drugs can pass through the skin.
The layer is selective about which particles can pass through the skin, allowing only those with specific physicochemical properties.
Drugs move passively across the stratum corneum via intercellular, transcellular, and transappendageal pathways.
When a compound penetrates the skin's outer layer, it may be removed by dermal processes or transported to deeper tissues.
Infiltration enhancers might work by altering the lipid structure between cells to increase diffusivity, according to the lipid-protein-partitioning hypothesis.
Scientists have found that they can alter the structures in the outer skin layer to control how substances move through the skin. This is achieved by adjusting the lipid makeup between skin cells and modifying protein areas

Niosomes can help medicine go into the skin. They work in the horny layer and spread the medicine. Niosomes have been studied a lot for putting medicine on the skin.
The text discusses the concept of conveyance and highlights its potential as an effective method for delivering active substances directly to the skin. This approach is suggested to enhance the targeting and application of various compounds to the epidermal layer efficient
Niosomes are gaining popularity in delivering drugs through the skin due to their unique features and properties.
The text discusses the essence of definitions related to drugs, including improved drug delivery and local methods for controlled drug release. This involves enhancing how drugs enter the body and managing how they are released within specific areas to improve their effectiveness.
The text discusses a method involving a discharge and rate-restricting layer to control the release and absorption of medication through the skin, ensuring effective treatment.

Mechanism of Action of niosomes permeation Enhancers
Niosomes enhance drug delivery through the skin, but no single factor fully explains how they do this.
The text describes proposed systems that involve adjusting the barrier function of the outermost layer of the skin, the stratum corneum.
The text discusses how skin issues can be due to changes in lipid organization, which can be reversed. It also mentions that reducing water loss from the skin can increase moisture, soften, and loosen the tightly packed skin structure.
Niosomes can attach to the skin's outer layer, as shown by advanced microscopy techniques. This leads to a strong activity of the drug where it contacts the skin.
Freeze crack electron microscopy and small-scale X-ray scattering reveal a high thermodynamic activity gradient of the drug at the interface.
The main focus is on drug saturation. Niosomes stick to cell surfaces without absorbing liquid or lipid parts.
The text discusses two ways a process might happen: either through direct forces or by binding at specific receptors on the vesicle layer, which then involves drug transfer.
Niosomes can deliver substances directly to the skin. They might also merge with cell membranes, allowing their contents to mix fully with the cell's interior.
Context, leading to the release of their contents into the cell. Thus, the niosome acts as a delivery system, ensuring substances reach specific targets within the body.

Conclusion
The niosomal drug delivery system is an important advancement in pharmacy. It represents significant progress in drug delivery technologies and nanotechnology.
Niosomes are considered a better dosage form than others because they are cost-effective and stable.
Encapsulated toxic anticancer drugs, anti-infective, and anti-AIDS treatments have significant potential. Niosomes are utilized to deliver these drugs effectively.
Niosomes improve bioavailability and targeting of drugs, helping reduce toxicity and side effects.
Niosomes are being incorporated into dosage forms to specifically target tissues and parts of the body. This approach aims to improve the delivery and effectiveness of drugs by reaching precise areas that need treatment. By using niosomes, medications can be more efficiently directed, potentially enhancing therapeutic outcomes and reducing side effects.

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